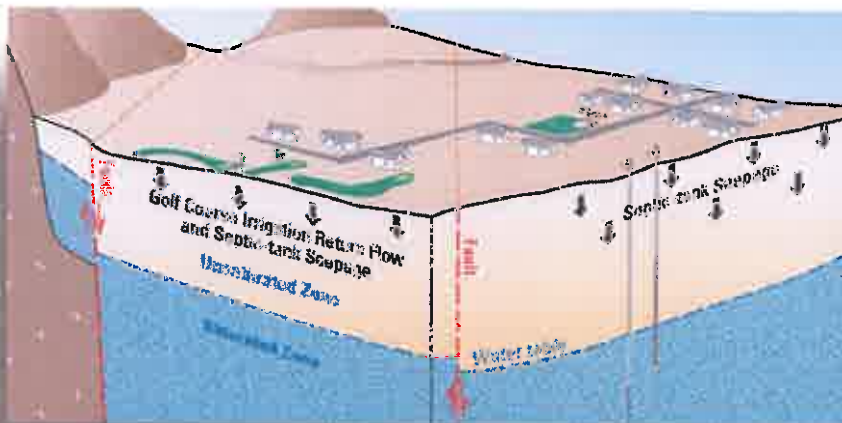


DESERT HOT SPRINGS WATER RECYCLING APPRAISAL STUDY: INTEGRATED RESOURCE PLAN - PHASE 1

FINAL REPORT

NOVEMBER 2004



PREPARED FOR:



MISSION SPRINGS WATER DISTRICT
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DESERT HOT SPRINGS, CA 92240

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**DESERT HOT SPRINGS WATER RECYCLING
APPRAISAL STUDY:
INTEGRATED RESOURCE PLAN
PHASE I**

November 2004

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1.0 INTRODUCTION

1.1 Overview

Mission Springs Water District (MSWD) was established in 1953 and was formerly called the Desert Hot Springs County Water District. The MSWD service area consists of 135 square miles including the City of Desert Hot Springs, 10 smaller communities in Riverside County, and communities in the City of Palm Springs. MSWD's water source is 100 percent groundwater, drawn from seven active production wells, providing water service to over 25,000 people as well as sewer service to approximately 8,000 people in Desert Hot Springs, Desert Crest Country Club, and Dillon Mobile Home Park.

1.2 Purpose

Mission Springs Water District (MSWD) has contracted PSOMAS to assist in the development of an Integrated Water Resource Plan to be utilized in implementing overall Mission Creek Sub-Basin management decisions. As part of this Plan, a Phase I Water Recycling Appraisal study was conducted that evaluated the following:

- Water Resources Availability – includes a general overview of the Mission Creek Sub-Basin, identification of water resources, and evaluation of the inflow/outflow to the Mission Creek Sub-Basin
- Water Quality – includes a general overview of the water quality of the Mission Creek Sub-Basin and potential threats to the existing water quality with a special emphasis on potential impacts from septic systems
- Groundwater Monitoring Program – describes existing groundwater monitoring along with a recommended program that includes water level monitoring and water quality sampling
- Quantification of Recycled Water – describes the anticipated quantity of recycled water and the potential uses and costs associated with the use of recycled water.
- Conceptual Recycled Water Management Options – describes a conceptual approach to utilizing recycled water for various uses in the Mission Creek Sub-Basin.

The results of these investigations and recommendations are included in this report. While not all-inclusive, the report provides an effective overview of the existing groundwater conditions, threats to existing water quality, availability of recycled water,

as well as a proposed plan to implement future recycled water use in the Mission Creek Sub-Basin.

1.3 *Funding*

Funding for this study was provided by the U.S. Bureau of Reclamation.

2.0 WATER RESOURCES AVAILABILITY

MSWD's water source is 100 percent groundwater, drawn from seven active production wells. Additional production from the Sub-Basin comes from the Coachella Valley District that has six production wells located in a small area in the south central portion of the Sub-Basin, and from approximately 200 private wells for domestic use. The following discussion provides a general overview of the Sub-Basin along with an evaluation of surface recharge, current extraction, and Sub-Basin outflow estimates.

2.1 *General Overview of the Mission Creek Sub-Basin*

2.1.1 Sub-Basin Description

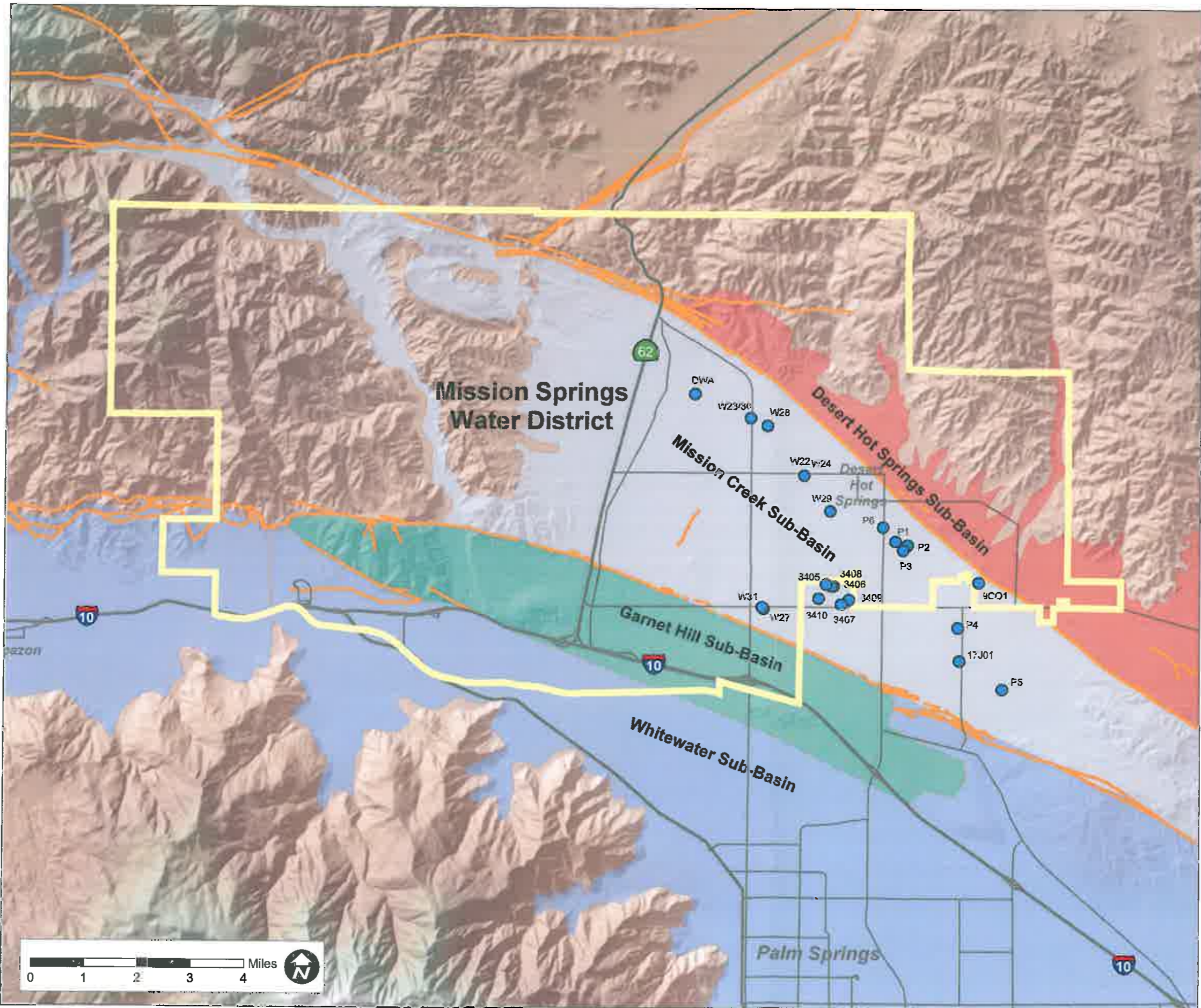
The Mission Creek Sub-Basin is located in the Upper Coachella Valley in the north central portion of Riverside County, California. The Mission Creek Fault and the Banning Fault bound the northern and southern edges of the Sub-Basin, respectively, and are the major groundwater controls. Both act to limit groundwater movement as these faults have folded sedimentary deposits, displaced water-bearing deposits, and caused once permeable sediments to become impermeable (California Department of Water Resources [DWR], 1964).

Major surface water features in the area are the Whitewater River, Mission Creek, San Geronio River, Little and Big Morongo Washes, and Long Canyon. The MSWD service area and groundwater Sub-Basin are presented on Figure 2-1.

2.1.2 Physiography and Climate

The Mission Creek Sub-Basin occupies approximately 77 square miles and is bounded on the south by the Banning Fault, on the north and east by the Mission Creek Fault, and bordered on the west by limited water-bearing rocks of the Little San Bernardino Mountains. To the southeast, the Sub-Basin merges with the Indio Hills (DWR, 1964).

The climate in the valley is typical desert with seasonal temperatures vary from about 115 degrees Fahrenheit in the summer to below freezing in the winter. The high mountains that border the valley to the west and north are an effective barrier against easterly moving coastal storms. The average annual rainfall on the valley floor is less than 6 inches; whereas, the average annual rainfall at the crest of the mountains to the west and north of the valley ranges from 30 to 40 inches (DWR, 1964).



Legend

- MSWD Service Area Boundary
- Known Fault Lines
- Groundwater Sub-Basins**
 - Whitewater
 - Mission Creek
 - Desert Hot Springs
 - Garnet Hill
- Selected Wells

Mission Springs Water District and Mission Creek Sub-Basin Boundaries

2.1.3 Population Growth

The MSWD is located within the Regional Statistical Area (RSA) 52. As part of the MSWD Water Master Plan dated May 2000, an analysis was undertaken to address future population growth. The analysis was based upon one previously undertaken by the Southern California Association of Governments (SCAG) and included in the MSWD Water Master Plan as reported by ASL Consulting Engineers (2000).

“SCAG determined populations for each census tract within the District service boundary. In cases where census tracts were not entirely within the District, the census tract data was prorated based on the percentage of area included in the service area boundary. Populations within each census tract were determined by SCAG using models based on socio-economic data for each area. “

Table 2-1 presents projected population growth in the Mission Springs Water District area.

Table 2-1
Projected Population Growth Breakdown per Census Tract

Tract ID	District	2000	2005	2010	2015	2020	2025 estimated
43806	6.4%	602	848	1,093	1,306	1,528	1,785
44501	46.8%	4,239	5,485	6,669	8,048	9,639	11,450
44502	96.3%	21,980	24,575	27,116	30,090	33,531	37,000
TOTAL		26,821	30,908	34,878	39,444	44,698	50,235

Based upon the year 2000 population of 26,821 and the projected year 2025 population of 50,235, the projected growth rate over the next 25 years is approximately 2.6%. The MSWD projected total build-out population according to the Water Master Plan is approximately 102,000.

2.1.4 Hydrogeologic Setting

The main water bearing units of the Mission Creek Sub-Basin are relatively undisturbed and unconsolidated Holocene and late Pleistocene alluvial deposits. These deposits form as detritus, eroding from the surrounding San Bernardino and Little San Bernardino Mountains, first filled topographic depressions and then are deposited on the piedmont alluvial fans. The individual beds are lenticular in shape and not extensive, but coalesce with other beds to form larger water bearing areas. Units included in these water-bearing deposits are: Ocotillo conglomerate, Cabezon fanglomerate and Holocene alluvial and sand dune deposits.

The Pre-Tertiary Crystalline rocks that underlie and constitute the northwestern and southeastern borders of the Sub-Basin are a complex assemblage of gneisses and schists, Precambrian in age, and have been intruded by younger granitic rocks associated with the Southern California batholith of Cretaceous age (DWR, 1964). DWR classified these rocks as “non-water-bearing.” However, DWR (1964) also acknowledges that in the surrounding mountains, the crystalline rocks may be the only source of water and that groundwater wells extract water from along faults and fractures within the system. With the amount of faulting in the area due to the San Andreas Fault Complex, it is possible that this igneous-metamorphic complex is highly fractured and may transmit groundwater more readily than previously assumed.

Faults and Barriers

The Mission Creek Fault and the Banning Fault create the northern and southern boundaries of the Mission Creek Sub-Basin, respectively. Differential movement along these faults has created more or less effective barriers to groundwater flow by deforming the alluvial sediments along the fault plane to create a poorly permeable zone.

The Mission Creek Sub-Basin is bounded on the west and east by barriers of uplifted poorly permeable consolidated bedrock of the San Bernardino Mountains and the Indio Hills, respectively.

Groundwater Levels and Storage

Regional water levels have been declining since the early 1950’s due to scarce annual precipitation and groundwater extractions (DWR 1964). Groundwater level data indicate that since 1952, water levels have declined at a rate of 0.5 to 1.5 feet per year (CVWD 2000). Current water levels vary in domestic wells from 140 to 721 feet below ground surface with an average depth to water being 372 feet (MSWD 2000).

Total groundwater storage capacity for the Mission Creek Sub-Basin is estimated to be 2.6 million acre-feet (DWR 1964). This is the amount of groundwater the Sub-Basin can theoretically contain using a maximum depth below surface of 1,000 feet. Actual groundwater in storage in the Mission Creek Sub-Basin is estimated at 1.4 million acre-feet (MSWD 2000).

2.2 Identification of Available Water Resources

Major surface water features in the area are the Whitewater River, Mission Creek, San Geronio River, Little and Big Morongo Washes, and Long Canyon. The local drainages are ephemeral streams that flow in response, during, and immediately following significant rainfall events. Moreover, water flowing along these creeks and washes is reported to disappear into the valley alluvium at or near the foot of the slopes (Proctor, 1958).

Other than lakes associated with golf courses and landscaping in housing developments, no surface water reservoirs are located in the Sub-Basin.

MSWD's water source is 100 percent groundwater currently drawn from seven active production wells pumping from the Mission Creek Sub-Basin.

2.3 Evaluation of Surface Recharge Components

Potential sources of surface recharge or inflow into the Mission Creek Sub-Basin include direct precipitation, surface water inflow, subsurface inflow, and returns from local groundwater sources and imported water serving wastewater, commercial, and irrigation purposes. A brief explanation of the methodology utilized in deriving each element of supply or inflow for the Mission Creek Sub-Basin is presented in the following subsections.

2.3.1 Surface Water Inflow

A study using Geographic Information System (GIS) technology was conducted to assess general values of precipitation and potential runoff data originating in local ungaged or poorly gaged watersheds that are hydraulically connected to basins in the Mission Springs Water District's service area. Figure 2-2 shows the study area map.

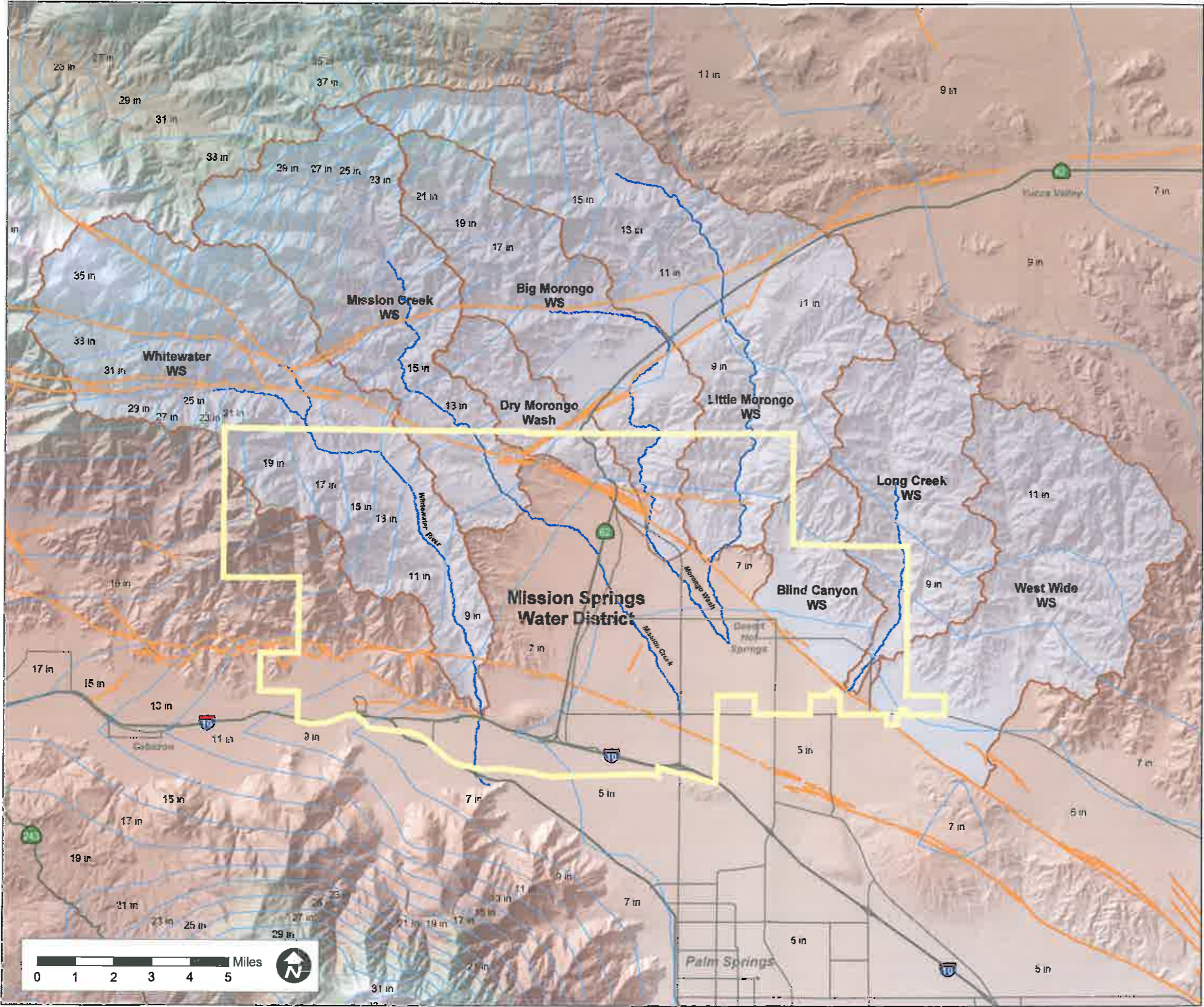
Precipitation Zone Values

ArcInfo Desktop was the GIS platform used for the study along with the Arc Hydro extension. The Arc Hydro extension was used to delineate local watersheds using a United States Geological Survey (USGS) 30-meter resolution Digital Elevation Model (DEM) of the study area. Arc Hydro is a basic watershed analysis tool and can create watersheds and perform basic hydrologic calculations quickly and efficiently.

Once local watersheds were delineated and their parameters, such as area and perimeter were calculated, a precipitation isohyetal contour map layer was overlaid onto the watersheds to determine precipitation zones within each watershed.

The California statewide precipitation data layer used in the study represents lines of equal rainfall (isohyets) based on long-term mean annual precipitation data compiled from the USGS, DWR, and California Geological Survey (CGS) map and information sources. Source maps are based primarily on U.S. Weather Service data for approximately 800 precipitation stations. The data were collected over a sixty-year period (1900-1960). The minimum mapping unit is 1000+ acres. The isohyetal contour intervals are variable due to the degree of variation of annual precipitation with horizontal distance.

- Legend**
- MSWD Service Area Boundary
 - Study Area Contributing Watersheds
 - Avg. Annual Precipitation Contours (in inches)
 - Known Fault Lines
 - Major Drainages



**Surface Precipitation &
Watershed Areas of the
Mission Creek Sub-Basin**

The next step was to digitize polygon shape files with boundaries defined by intersections of the isohyets and borders of each watershed. These polygons were defined as precipitation zones and would then have attributes unique to each watershed and a specific precipitation amount. By calculating polygon area and multiplying by precipitation, an areal amount of mean annual precipitation was calculated for each precipitation zone for each watershed in the study area. Once calculated, these values were entered as attributes into the polygon shape file's database for future reference, analysis, and map generation.

Potential Runoff

The next step was to estimate potential runoff. For this study potential runoff is defined as the amount of precipitation that becomes a surface water flow and is conveyed through the watersheds via drainages and creeks. This surface flow has a loss component where surface water is infiltrating into the local sediment vadose zone or bedrock fracture system and potentially recharging the groundwater aquifer. Due to the arid nature of study area potential runoff is closely correlated to the amount of water that is available for aquifer recharge via deep percolation.

To understand what percentage of overall precipitation is available as runoff, research was conducted to locate previous works or studies that dealt with the precipitation/runoff and percolation question for arid regions. Several definitive studies exist that deal with runoff and recharge in this region and were used as reference material. They are:

1. DWR. 1964. Coachella Valley Investigation. Bulletin 108. In it DWR references two other previous works;
 - a. DWR. 1930. Rainfall Penetration and Consumptive Use of Water – in Santa Ana River Valley and Coastal Plain.
 - b. H.F. Blaney and W.D. Criddle. 1950. Determining Water Requirements in Irrigated Areas from Climatological and Irrigation Data. U. S. Dept. of Agriculture, Soil Conservation Service.
2. Coachella Valley County Water District. 1964. Engineering Report on Preliminary Design and Cost Estimate for Flood Control Works for the Edom Area. Prepared by Bechtel Corporation.
3. S.E. Rantz and T.E. Eakin. 1971. A Summary of Methods for the Collection and Analysis of Basic Hydrologic Data for Arid Regions. USGS. Prepared in Cooperation with DWR. (This report alone incorporated over 100 selected references).

Rantz (1971) describes the difficulty in obtaining reliable long-range hydrologic data such as stream flow runoff in many arid regions. Stream gage sites are difficult to construct and maintain in arid regions, as desert streams are usually ephemeral, braided and migrate or shift frequently during periodic storm events. These storms cause

streambeds to scour and change geometric shape, which increase error rates in the stage discharge relationship that lies at the heart of stream gage data analysis.

In the MSWD area the runoff is also quickly permeating into alluvial fans or the valley floor. The precipitation that permeates the soil is almost entirely retained in the upper layers of the ground and is lost later by evaporation or evapotranspiration; only a minor amount penetrates to the ground-water body below. Rantz cites Davis and De Wiest (1966) illustrating this fact concerning precipitation on the desert floor with the following example:

“For example, a soil that has a specific retention of 15 percent and is depleted of moisture to a depth of 2 feet during the summer heat will require 3.6 inches of rain merely to make up for the soil-moisture deficiency. If the rain occurs at several different times during the year, intervening periods of dry weather will cause the loss of water from the soils so that amounts much in excess of 3.6 inches will be needed to start (groundwater) recharge.”

Soil moisture deficiency coupled with infrequent and sporadic storm events makes estimating runoff in ungaged desert areas difficult. Various methods have evolved over time and Rantz introduces and describes many of them. One method that Rantz addresses for estimating runoff in ungaged areas was devised for a study in the Colorado Desert region by Hely and Peck (1964).

Hely and Peck Method

The Hely and Peck method uses an isohyetal map of mean annual precipitation levels and daily precipitation records for seven widely spaced desert stations. The data are tabulated and average values can be distributed throughout the study area. For example the tables show that 10 percent of the mean annual precipitation occurs in storms that have depths averaging 0.08 inch, and 24 percent occurs in storms that have depths averaging 0.25 inch.

The next step is to convert this precipitation distribution to equivalent average annual yield. This was done by using a modification of a method described in publication by the U.S. Soil Conservation Service (1957) and U.S. Bureau of Reclamation (1960). A principal element of the method is a family of curves. The curves are numbered from 0 to 100, in order of increasing runoff. Curve 0 would apply to a sand or gravel so permeable that no direct runoff would occur for any rainfall. Curve 100 represents the unattainable condition of 100-percent runoff. The curve numbers between 0 and 100 are determined by a formula and are not percentages.

Hely and Peck related the runoff producing characteristics of subareas in the region to runoff-curve numbers. Runoff curve numbers are directly correlated to soil complexes. The method Hely and Peck devised to accomplish the relationship involved the determination of an infiltration index for various subareas. Infiltration tests were run at nearly 100 test sites in the region by use of a portable infiltrometer of the rainfall

simulator type and supplemented by several hundred observations of the behavior of water poured into shallow depressions.

To apply the technique to determine average annual runoff from an ungaged area the curves are first used for selecting the appropriate runoff-curve number from a specific subarea. This runoff-curve number is then applied to another graph to obtain the mean annual runoff, expressed in percentage of mean annual precipitation. This percentage, when multiplied by the mean annual precipitation, as determined from a regional isohyetal map, gives the mean annual yield, expressed in inches. The procedure is repeated for all subareas in the basin to obtain mean annual yield for the entire basin.

The calculated mean annual yield value is the amount of water that could potentially recharge aquifers. Using the Hely and Peck method values are obtained ranging from about 2 to 20 percent of total mean annual precipitation for subareas within the MSWD service area and surrounding watersheds. In an effort to further refine the runoff value calculated using the Hely & Peck methodology, Psomas reviewed 35 years of USGS gage station flow data for Mission Creek. The data indicated an annual average flow of approximately 2100 acre-ft/year for the 35-year record. This would equate to approximately 4% of the estimated average annual precipitation that would fall on the basin as shown in Table 2-2 (areal precipitation estimate of 51,542 acre-ft/year for the Mission Creek drainage). Given that the USGS gage probably underestimated (due to poor records in gaging a stream in an arid environment) the total flow from Mission Creek, Psomas has estimated that the annual average flow is approximately 5% of the precipitation value. Applying this percentage to the total value of precipitation for the watershed (136,680 acre-feet/year [AF/yr]) gives an estimated surface runoff value of approximately 6830 AF/yr of inflow into the groundwater basin and is presented in Table 2-2.

Table 2-2 Values for Watershed Precipitation Zones				
Precipitation (inches)	Watershed	Acres	Areal Precipitation (Acre-ft/year)	Estimated Runoff (Acre-ft/year)
18	Mission Creek	5,149	7,724	386
27	Mission Creek	2,638	5,936	297
23	Mission Creek	10,927	20,943	1047
14	Mission Creek	2,610	3,045	152
11	Mission Creek	3,568	3,271	164
9	Mission Creek	4,263	3,197	160
8	Mission Creek	11,139	7,426	371
	Sub-totals	40,295	51,542	2577
14	Big Morongo	6,123	7,143	357
18	Big Morongo	7,200	10,800	540
11	Big Morongo	6,460	5,922	296
8	Big Morongo	3,090	2,060	103
9	Big Morongo	3,748	2,811	141
	Sub-totals	26,621	28,736	1437
23	Little Morongo	1,542	2,956	148
23	Little Morongo	5,258	10,079	504
14	Little Morongo	4,588	5,352	268
11	Little Morongo	4,861	4,456	223
9	Little Morongo	13,499	10,124	506
8	Little Morongo	8,919	5,946	297
	Sub-totals	38,668	38,914	1946
8	Long Creek	19,685	13,123	656
9	Long Creek	1,335	1,001	50
	Sub-totals	21,020	14,125	706
8	Blind Canyon	5,045	3,363	168
	Total	131,649	136,680	6834

A value for surface water inflow into the basin is difficult to provide due to lack of precise long term monitoring data, climatic variation, high potential evapotranspiration rates and rapid infiltration rates for surface runoff.

Data from a USGS stream gage in Mission Creek shows that stream flow is prevalent during periods of high rainfall and at other times when flow is absent. The long-term (35 years) annual average discharge is approximately 2,100 AF/yr (USGS web site) for Mission Creek. Stream flows range from zero to as high as 540 cubic feet per second and flows are rapidly dispersed downstream into the alluvium (Richard C. Slade & Associates LLC [Slade], 2000).

It is believed that no other streams that drain directly into the Mission Creek Sub-Basin are currently gaged, although the USGS did gage Long Creek for a short period of record

(7 years). This stream drains into the Desert Hot Springs basin and probably contributes to subsurface inflow into Mission Creek Sub-Basin across the Mission Creek Fault. Proctor (1968) noted that water flowing from the washes and creeks originating in the surrounding mountains tends to disappear into the valley alluvium at the foot of the slopes. This indicates that the amount of rainfall recharge to the groundwater basin from mountain runoff may be significant (Slade, 2000). Therefore, using the Hely and Peck Method described above, Psomas estimated the surface inflow from the following surface water drainages: Mission Creek and the Morongo Canyon Wash system (which consists of Big Morongo, Little Morongo and Morongo Canyon washes, Blind Canyon, West Wide Canyon, and Long Creek).

Table 2-2 presents estimated runoff values from precipitation throughout the watershed of the Mission Creek Sub-Basin. The total for the watershed is estimated at approximately 6834 AF/yr delivered into the Mission Creek Sub-Basin from surface water flow via the sources listed above.

2.3.2 Direct Precipitation

DWR in their 1964 “Coachella Valley Investigation” conducted a thorough hydrologic study of the entire valley. At Desert Hot Springs, DWR reported direct precipitation averaged less than 6 inches per year on the valley floor over a 20-year period of record. Annual precipitation of less than 12 inches per year results in negligible deep percolation to the water table (DWR, 1930) due to evapotranspiration. Therefore, the contribution of direct precipitation upon the valley floor of the Mission Springs Sub-Basin is considered to be negligible.

2.3.3 Subsurface Inflow

Several subsurface inflow recharge systems have been identified for the Mission Creek Sub-Basin. These sources originate from precipitation in the surrounding mountains and include; subsurface inflow from Mission Creek, and the general flux of groundwater from Desert Hot Springs Sub-Basin across the Mission Creek Fault. Because the Mission Creek Fault would disrupt subsurface flow from the Morongo Canyon Wash system, any subsurface flow attributed to the Morongo Wash system would be included as part the groundwater flux across the fault.

For Mission Creek, darcian flow in porous media can be calculated by the equation:

$$Q=KIA$$

Where,

Q=flow in gallons (gal)/day

K=hydraulic conductivity in gal/day/feet² (ft²)

I= groundwater gradient (unitless)

A= cross-sectional area of saturated thickness in ft²

An estimate of the subsurface inflow from the Mission Creek alluvium west of Indian Avenue was made by taking an average hydraulic conductivity (K) value of 40 gal/day/ft² [MTU (1998) suggested an average value of K ranging from 2.0 to 300 gal/day/ft²] for the alluvium, a hydraulic gradient of 0.0067, and an area of 13,200,000 ft². The resulting value is 10.9 AF/day or 3,979 AF/yr.

In addition to subsurface inflow associated with the various drainages, estimates have been made by Mayer and May (1998) addressing the inflow of groundwater to the Mission Creek Sub-Basin from the Desert Hot Springs Sub-Basin across the Mission Creek Fault at approximately 3,080 AF/yr.

2.3.4 Imported Water

Although several studies investigating the possibility for a long-term recharge program in the Mission Creek Sub-Basin have been completed, a recharge program has not yet been fully implemented. In 1997, Desert Water Agency (DWA) constructed a series of recharge ponds in the upper portion of the Mission Creek Groundwater Sub-Basin but has been able to complete only one cycle of imported water recharge. In 2002, approximately 4,000 AF of water was imported into the basin.

The possibility of future recharge depends largely on the availability of water from the Metropolitan Water District's Colorado River Aqueduct and on agreement with DWA. Thus, in our overall analysis we have not assumed that a long-term periodic recharge program will provide inflow to the Mission Creek Groundwater Sub-Basin.

2.3.5 Wastewater Deliveries and Return Flows

MSWD currently operates two wastewater treatment plants (see Section 5.1.1) serving a total of approximately 3,012 developed parcels. The plants are the Horton Treatment Plant and the Desert Crest Treatment Plant with capacities of 2,500,000 gal/day (2,800 AF/yr) and 180,000 gal/day (202 AF/yr), respectively. Following secondary treatment, the undisinfected secondary wastewater effluent enters percolation ponds where it infiltrates into the basin. The amount of water the treatment ponds recycle via percolation ponds has steadily increased over the last several years. For the purpose of

this evaluation, we have assumed a constant annual percolation of approximately 1,013 AF/yr (MSWD 2000).

Additional recharge to the basin attributed to the approximately 5,500 un-sewered private disposal systems is estimated based on the following assumptions: 1) each system is part of a private domestic water system with a per annual consumption of water of 0.27 AF/yr; and 2) approximately 23% of the water is returned to groundwater through infiltration in the septic system (MTU, 1998). Thus,

$$0.27 \text{ AF/yr} \times 5,500 \text{ users} \times 0.23 \text{ return water} = 341 \text{ AF/yr return flow from domestic un-sewered disposal systems}$$

In addition, return flows associated with the application of water to golf courses, resort landscape watering, and agricultural irrigation practices are expected to contribute to overall inflow to the Sub-Basin. MTU (1998) has suggested that 20% of the water consumed by golf courses would be returned to groundwater. Assuming a total production of 1,510 AF/yr, total return flow from golf courses, resort landscape watering and agricultural irrigation practices is estimated at 302 AF/yr.

2.4 Evaluation of Current Extraction and Basin Outflow

Potential sources of outflow from the Mission Creek Sub-Basin include surface water outflow, subsurface (groundwater) outflow, evapotranspiration losses, and pumping. A brief explanation of the methodology utilized in deriving each element of outflow for the Mission Creek Sub-Basin is presented in the following subsections.

2.4.1 Surface Water Outflow

Due to high infiltration and evapotranspiration rates for surface water there is little or no surface outflow from the basin. Perennial streams do not exist and stream flow is usually intermittent and caused by localized high intensity precipitation storms that create sudden discharges of rainwater runoff. Surface water is quickly absorbed by the sediments where plants in the vadose zone take up a limited amount of water and the remaining continues to percolate into the groundwater table. For this hydrologic budget a value of 1% (~ 70 AF/yr) of the surface water inflow is estimated to flow out of the Sub-Basin boundaries during periods of high volume precipitation.

Geotechnical Consultants [GTC] (1979) details the rapid infiltration of surface runoff into the coarse grained alluvium of the Mission Creek Sub-Basin. During a major storm event in 1977-1978, GTC estimated the southeasterly surface flows within Mission Creek Groundwater Sub-Basin from Indian Avenue to Dillon Road where flow decreased from 1,980 gallons per minute (gpm) to 0 gpm. During this event GTC states that most of the surface runoff was from Mission Creek and that Little and Big Morongo Creek washes had little to no runoff.

2.4.2 Subsurface Outflow

Subsurface outflow from the basin occurs along the southeasterly trending portion of the Banning fault that marks the boundary of the Mission Creek Sub-Basin with the Garnet Hill Sub-Basin. At this boundary groundwater meets a less permeable zone of sediments produced by faulting activity that folded sedimentary deposits, displaced water-bearing deposits, and caused once permeable sediments to become less permeable. This is evidenced by water level measurements taken from two wells on opposite sides of the fault. Each time these measurements have been taken the water levels are higher in the Mission Creek Sub-Basin than the adjacent Garnet Hill Sub-Basin.

As groundwater flows towards the Banning fault zone, it meets resistance due to the lower permeability of the fault zone. This is evidenced by historically higher water levels near the fault zone relative to water levels throughout the Mission Creek Sub-Basin. As the pressure of the groundwater builds up against the fault zone some groundwater escapes the basin across the lower permeable zone into the Garnet Hill Sub-Basin.

At this time, the quantity of flow across the fault has been estimated using various methods. These methods take into account the permeability of the sediments, saturated cross sectional area of sediments in contact with the fault, hydraulic gradient, and the permeability across the fault zone.

Based on these previous values of 2,000 AF/yr (Tyley, 1974) to 5,470 AF/yr (Mayer and May, 1998), Psomas has selected a median value of outflow on the order of 3,200 AF/yr

2.4.3 Evapotranspiration

Evapotranspiration is the amount of surface or groundwater that evaporates into the atmosphere or is utilized by plants. DWR (1964) reports evaporation averaging 75 inches per year from free water surfaces. This evaporation rate is within the same range as other published values for the region.

Phreatophytes (plants) along faults in the basin have been estimated to consume 1,400 to 1,500 AF of water each year. Mayer and May (1998) estimated the total area populated by phreatophytes to be 1,123 acres. Mesquite is the dominant phreatophyte found along the Mission Creek and Banning faults. The amount of water extracted from the aquifer by the phreatophytes was estimated using the approach of Lines and Bilhorn (1996) who have estimated transpiration losses from phreatophytes in the Mojave Desert. They estimated that the annual water consumption by mesquite was 1.3 AF/acre. This method used in the Mojave Desert seems to correlate well to the Mission Creek basin area. Using these values an approximation of 1,460 AF/yr is estimated as loss from the Sub-Basin due to evapotranspiration.

2.4.4 Pumping

Groundwater pumping in the Sub-Basin can be reported in two categories: 1) Public pumping (MSWD and CVWD); and 2) private pumping from golf courses and resorts and domestic wells. Public well pumping extracts the highest amount of groundwater annually, followed by golf course and resort pumping. In 2003, MSWD reported groundwater extraction in the basin was 8,567 AF for MSWD and 4,425 AF for CVWD. The major private users including Hidden Springs, Mission Lake Country Club, and Sand Resort extracted approximately 1,510 AF of groundwater in 2003. Pumping from private domestic wells in the MSWD service area is estimated at approximately 225 AF/yr. This figure is based upon an assumption of approximately 200 private domestic wells producing groundwater at a rate of approximately 1000 gallons per day each. Therefore, total groundwater extraction by pumping from the Mission Creek Sub-Basin is estimated at approximately 14,727 AF/yr. Figures on domestic pumping rates are difficult to estimate due to the lack of a comprehensive groundwater well monitoring program to provide data on well locations, current use, and pumping rates.

2.4.5 Summary of Inflow/Outflow to Mission Creek Sub-Basin

Total outflow from the basin has been approximated at 19,400 AF/yr with inflows to the basin estimated at 15,500 AF/yr suggesting that the basin may be in overdraft up to 3,900 AF/yr (Table 2-3). Basin overdraft has been historically documented by declining water levels recorded in parts of the Sub-Basin. The annual hydrologic budget for the Mission Creek Sub-Basin is summarized in Table 2-3 and presented diagrammatically in Figure 2-3.

TABLE 2-3
SUMMARY OF INFLOW/OUTFLOW COMPONENTS
MISSION CREEK SUB-BASIN

INFLOW COMPONENT	RATE (AF/yr)	% OF TOTAL INFLOW
1.) Precipitation	0	0.0%
2.) Surface Water Inflow	6,834	44.0%
3.) Subsurface Inflow	7,059	45.4%
4.) Imported Water Storage	0	0%
5.) Wastewater Deliveries and Return Flows	1,656	10.7%
TOTAL INFLOW	15,549	---
OUTFLOW COMPONENT	RATE (AF/yr)	% OF TOTAL OUTFLOW
1.) Surface Water Outflow	70	0.4%
2.) Subsurface Outflow	3,200	16.4%
3.) Evapotranspiration	1,460	7.5%
4.) Groundwater Extraction	14,727	75.7%
TOTAL OUTFLOW	19,457	---
INFLOW-OUTFLOW	-3,908	

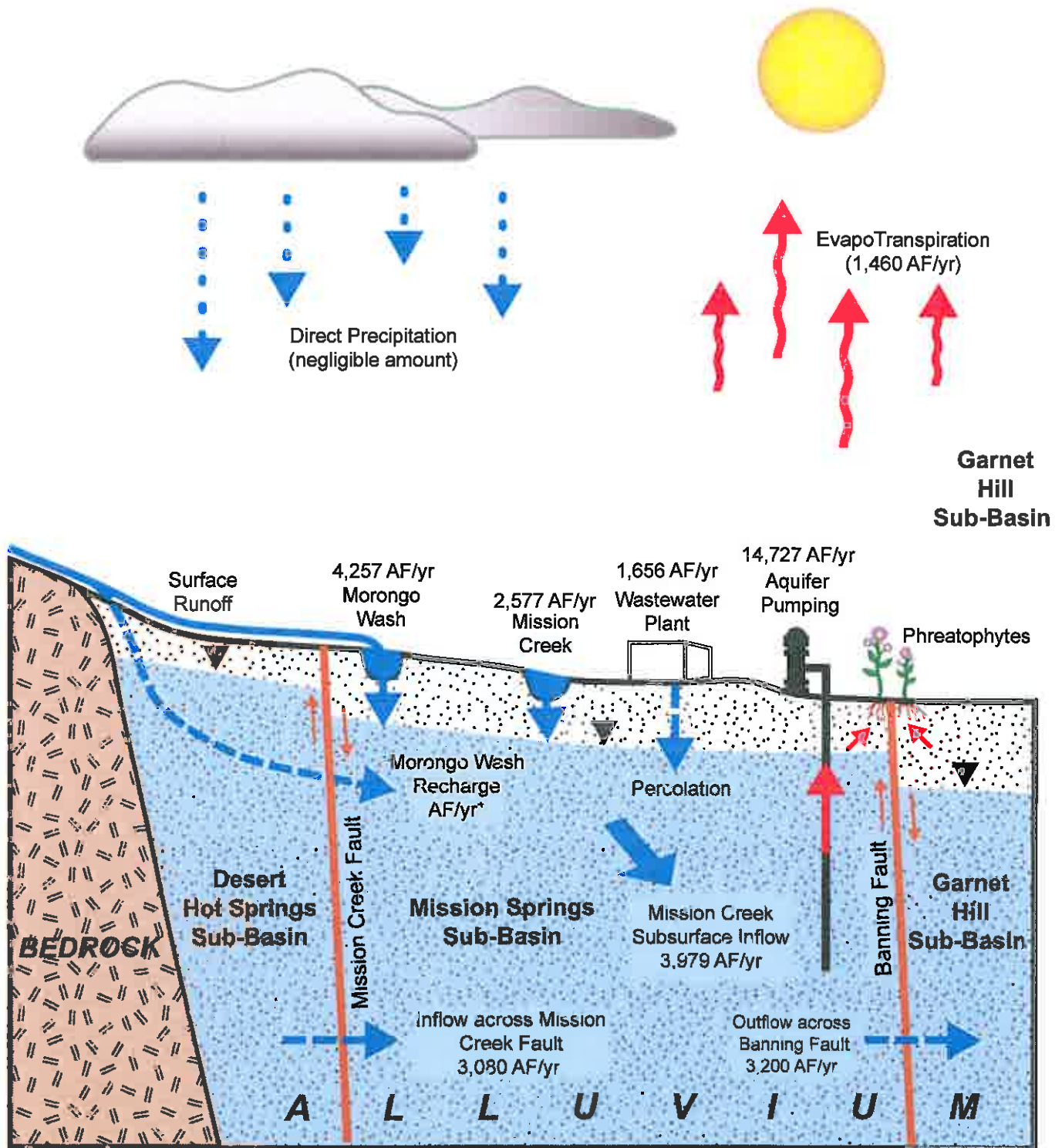
2.5 Groundwater Levels

MSWD along with various entities have monitored groundwater levels in the Mission Creek Sub-Basin for selected wells for many years. In order to develop an approximate change in storage for a given time period, Psomas used data collected by Slade (1991) as well as data collected or extrapolated for calendar year 2004. Table 2-4 presents groundwater elevations for selected wells in the Mission Creek Sub-Basin.

Groundwater contours were developed for 1991 and for 2004 (see Figures 2-4 and 2-5, respectively). The change in groundwater levels between 1991 and 2004 was estimated and is presented in Figure 2-6.

The contoured portion of the Sub-Basin, shown in Figures 2-4 and 2-5, represents the area in which most of the groundwater extractions are occurring and encompasses

Desert Hot Springs Water Recycling Appraisal Study: Integrated Resource Plan - Phase I



*Included as part of inflow across Mission Creek Fault

Mission Creek Subbasin and Water Budget Summary

Figure 2-3

TABLE 2-4
WELL LOCATIONS AND GROUNDWATER ELEVATIONS FOR
1991 AND 2004 CONTOUR MAPS

Well Identification No.	State Well Number	Surface Elevation (feet msl)	1991 Ground-water Elevation (feet msl)	2004 Ground-water Elevation (feet msl)	Perforation Interval (feet bgs)	Comments
CVWD 3405	03S04E12C01	888	726.5	703.5	200-480	CVWD WELL
CVWD 3407	03S04E12H01	844	726.9	705.1	122-147 172-192	CVWD WELL
MSWD W22	02S04E36D01	1106	728.0	705.7	390-780	MSWD WELL 22
W24	02S04E36D02	1096	727.0	703.8	406-790	MSWD WELL 24
W27	03S04E11L02	879	732.0	706.4	180-380	MSWD WELL 27
W28	02S04E26D01	1241	725.1	701.1	590-890	MSWD WELL 28
W29	02S04E36K01	1014	726.0	698.8	410-930 970-1050	MSWD WELL 29
W31	03S04E11L04	877	740.5	712.9	270-470 650-670 920-940 980-1000	MSWD WELL 31
W30	02S04E23N01	1282	723.2	706.7	640-1080	MSWD 23/NEXT MSWD 30
#1	UNKNOWN ATT	900	725.0	702.5	Unk	Feb 2004 measurements from MSWD with no well names and digital location data. Used GIS and a written location description to determine x,y and z coordinates.
#2	UNKNOWN ATT	890	725.0	706.6	Unk	Feb 2004 measurements from MSWD with no well names and digital location data. Used GIS and a written location description to determine x,y and z coordinates.
#3	UNKNOWN ATT	881	725.0	705.2	Unk	Feb 2004 measurements from MSWD with no well names and digital location data. Used GIS and a written location description to determine x,y and z coordinates.
#4	UNKNOWN ATT	863	727.5	713.2	Unk	Feb 2004 measurements from MSWD with no well names and digital location data. Used GIS and a written location description to determine x,y and z coordinates.
#5	UNKNOWN ATT	800	720.0	712.0	Unk	Feb 2004 measurements from MSWD with no well names and digital location data. Used GIS and a written location description to determine x,y and z coordinates.
9CO1	03S05E09C01	1004	731.1	718.0	262-334	Extrapolated from various reports including Mayer & May and Fox.
17J01	03S05E17J01	796	725.6	707.0	340-375	Extrapolated from Mayer & May report which used well as control point.
DWA Monitor Well	02S04E21J01	1450	906.5	906.5	500-630 670-790 850-1000	Extrapolated from two points then decided to use just the one known measured value.

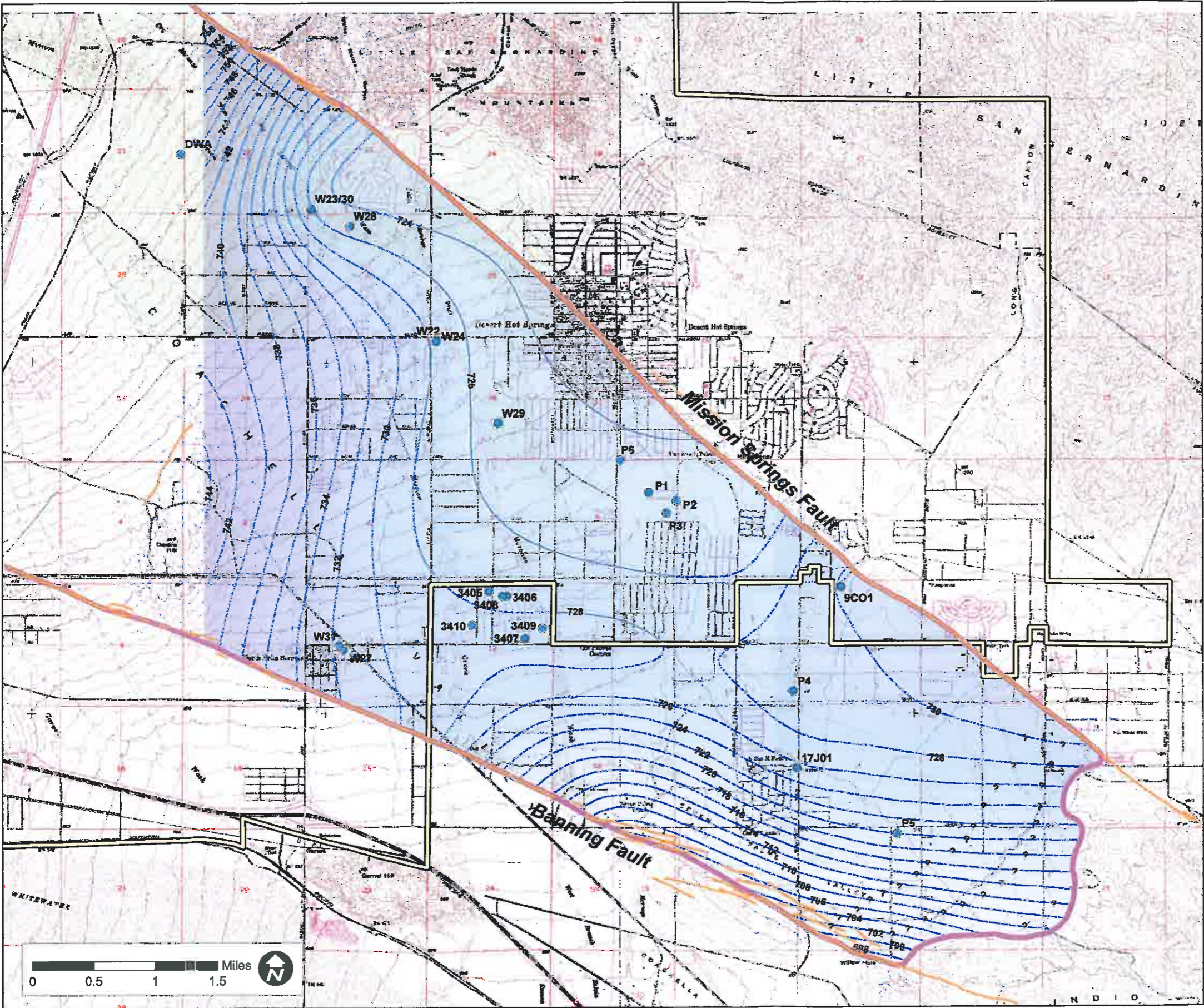
Desert Hot Springs Water Recycling Appraisal Study:
Integrated Resource Plan - Phase I

Legend

- MSWD Service Area Boundary
- Mission Creek Sub-basin Boundary
- Known Fault Lines
- Selected Wells
- Groundwater Elevation Contours 1991
(2-Foot Contour Interval)

Groundwater elevation surface based on contours depicted on the map, "Water Level Contours Spring 1991", contained in the report, Mission Springs Water District Groundwater Resources Investigation - Update" by Robert C. Fox (September 1992).

Question mark areas indicated on original map or denote areas interpolated to edge of Mission Creek sub-basin boundary.



Groundwater Elevation - 1991



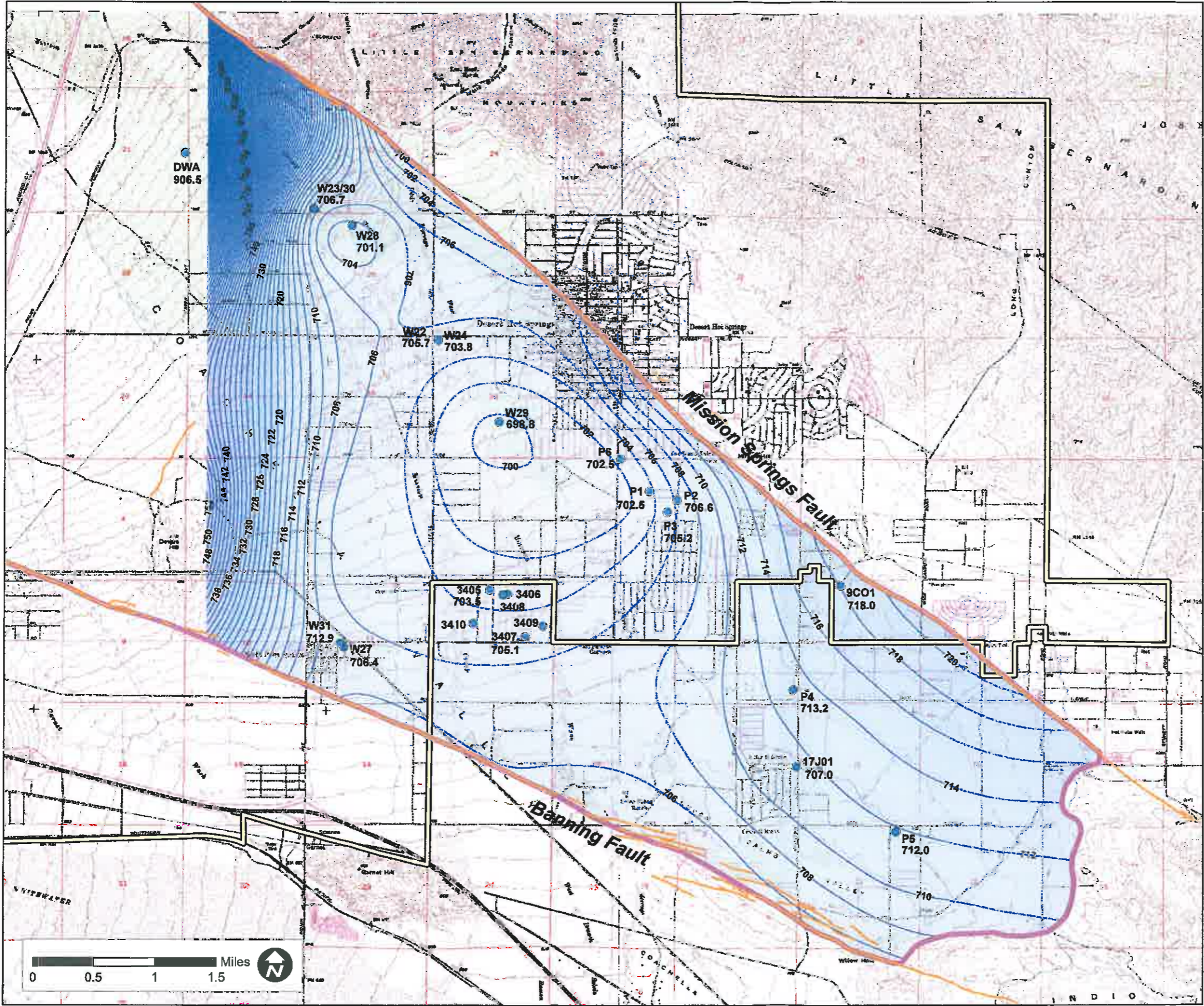
Figure 2-4

Desert Hot Springs Water Recycling Appraisal Study:
Integrated Resource Plan - Phase I

Legend

- MSWD Service Area Boundary
- Mission Creek Sub-basin Boundary
- Known Fault Lines
- Selected Wells
- Groundwater Elevation Contours 2004
(2-Foot Contour Interval)

Groundwater elevation contours based on 2004 data
from selected wells and professional judgment.



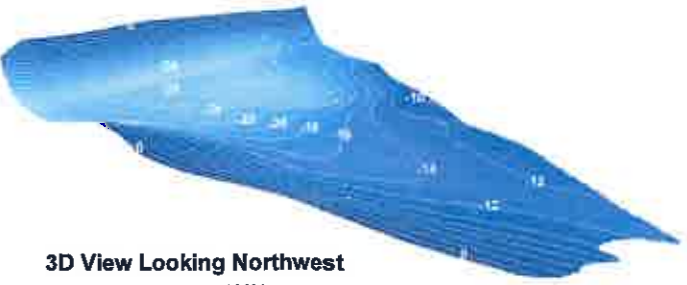
Groundwater Elevation - 2004



Figure 2-5

Legend

- MSWD Service Area Boundary
- Mission Creek Sub-basin Boundary
- Known Fault Lines
- Selected Wells
- Change in Groundwater Elev. (1991-2004)
(2-Foot Contour Interval)

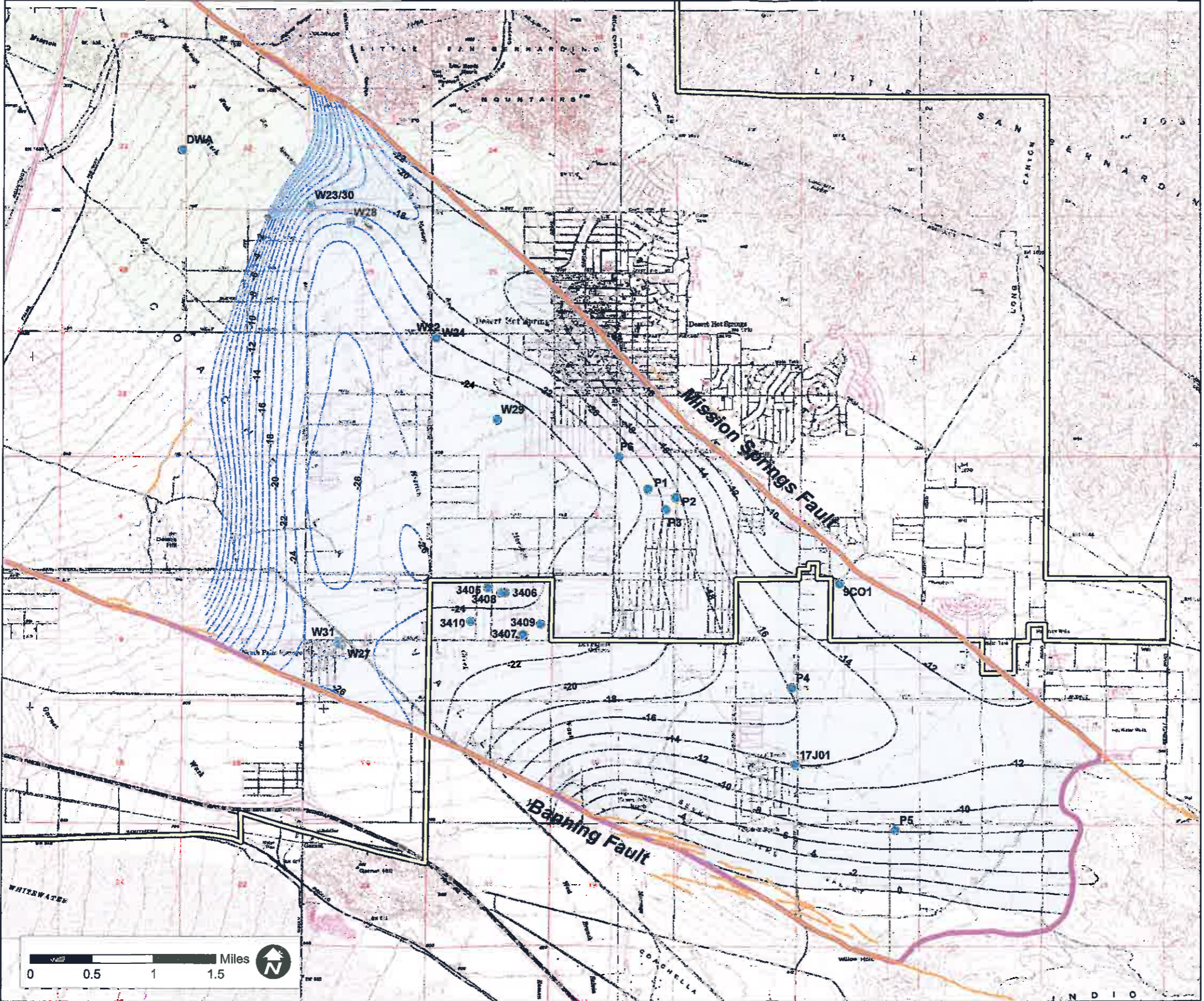


3D View Looking Northwest
Vertical Exaggeration: 100X

Changes in Groundwater
Elevation 1991-2004



Figure 2-6



approximately 30 square miles. The change in volume between the 1991 groundwater contours and the 2004 groundwater contours was calculated for this area and multiplied by the average storage coefficient. Historically, storage coefficients ranging from 0.15 to 0.18 have been assigned to the Sub-Basin (Tyley, 1974, GTC, 1979). Recent data collected and evaluated for the Mission Creek Sub-Basin has indicated that the average storage values for the Sub-Basin may be higher. Psomas (2004) and Michigan Technology University (1998) were able to achieve good model calibration using 0.225 as the storage value.

This approach yielded an estimated decrease in storage of approximately 57,500 acre-feet for the 13-year period (or an average decrease in storage of approximately 4,423 AF/yr.).

3.0 WATER QUALITY

3.1 *Existing Groundwater Quality*

Historic groundwater quality data for the Mission Creek Sub-Basin was evaluated by Slade (2000) from samples taken from MSWD and CVWD wells between 1961 and 1998 and is summarized as follows:

- Groundwater in the Sub-Basin ranges in character from a calcium-magnesium bicarbonate type in the northwest to sodium chloride-sulfate type in the southeast.
- Total dissolved solids (TDS) concentrations in groundwater samples taken from MSWD/CVWD municipal wells ranged from 271 mg/L to 490 mg/L. All samples analyzed were below the State of California recommended Secondary Maximum Contamination Level (MCL) of 500 mg/L for TDS.
- Total hardness has historically ranged from 56 mg/L to 252 mg/L as measured in municipal wells. These concentrations indicate moderately hard to hard water.
- The pH concentration of groundwater in the MCGS has ranged from 7.2 to 8.3.
- Nitrate as NO_3^- concentrations have ranged from not detected (ND) to 7.6 mg/L.
- Iron (Fe) concentrations have ranged from ND to 0.242 mg/L, below its State of California Secondary MCL of 0.300 mg/L.
- Magnesium (Mg) ranged in concentration from ND to 0.010 mg/L, below its State of California Secondary MCL of 0.050 mg/L.

Table 3-1 presents general water quality characteristics of groundwater produced from selected wells in the Sub-Basin.

Table 3-1
General Water Quality Characteristics from Selected Wells
Mission Creek Sub-Basin

Constituent	MSWD Well 22	MSWD Well 27	CVWD Well 3408	Range
Total dissolved solids (mg/L)	412-452	271-292	395-404	271-452
Calcium (mg/L)	57.8-63.8	35-43.1	44-58	35-63.8
Magnesium (mg/L)	14-20.3	4.9-6.7	9.9-13	4.9-20.3
Sodium (mg/L)	57.2- 68.5	45.7-56.6	63-64	45.7-68.5
Potassium (mg/L)	7.9-8.2	2.7-8.8	7.3-8	2.7-8.8
Bicarbonate (mg/L)	193-237	137-150	131-182	131-237
Sulfate (mg/L)	74.9-186	58-84.4	160-161	58-186
Chloride (mg/L)	17.2-54.2	23.9-35	15-16	15-54.2
Hardness (mg/L)	219-240	110-134	146-200	110-240
pH (units)	7.2-7.8	7.83-8.13	7.5-8.4	7.2-8.4
Nitrate as NO ₃ (mg/L)	3.1-6	ND-5.9	2.8-4.7	ND-6
Iron (mg/L)	ND	ND	ND-0.09	ND-0.09
Manganese (mg/L)	ND	ND	ND-0.01	ND-0.01

Source: Slade (2000)

3.2 Threats to Existing Groundwater Quality

The Mission Creek Sub-Basin is located beneath both developed and undeveloped areas. Given the high permeability of the surface sediments and the presence of residential/commercial/industrial activities within the Sub-Basin boundaries, there is a possibility that the underlying groundwater could be impacted by various activities currently occurring or proposed in the Sub-Basin. While not all inclusive, Psomas believes the following activities may pose the greatest threat to the existing groundwater quality in the Sub-Basin:

- Abandoned/inactive wells
- Commercial/industrial discharges
- Water import
- Septic systems

3.2.1 Abandoned/Inactive Wells

For purposes of this report, abandoned/inactive wells are defined as water wells that have been abandoned and/or inactivated by the owner and which an active well maintenance program is not maintained.

Often, previous owners may abandon a well due to dropping water levels or casing/screen failure and fail to properly abandon the well due to the high cost for abandonment following the State of California and local requirements. These wells often can act as a conduit for contaminants to enter the deeper groundwater system. In addition, where natural filtering/biological action as water moves through hundreds of feet of sediment (the unsaturated zone) can remove most contaminants associated with septage, the presence of a conduit can short circuit the system and allows contaminants to enter the drinking water aquifer.

3.2.2 Commercial/Industrial Discharges

Some commercial/industrial operations require the use of chemicals and/or hazardous materials as part of their operations. In addition, they may create hazardous materials as part of their operations and require this material to be disposed of at a qualified disposal/recycling facility. Some of the more common type of facilities that use hazardous materials includes:

- dry cleaning facilities
- gasoline stations
- operations with underground storage tanks for fuel and/or oil
- automotive repair facilities

Often, these facilities/operations will have inadvertent releases of hazardous materials/wastes into subsurface soils. Given the presence of highly permeable soils underlying most of the area, the contaminants associated with these releases can travel hundreds of feet in several years and enter the underlying groundwater. Often these contaminants are persistent and do not breakdown in the environment. They can persist for decades as they are poorly attenuated by highly permeable soils and have low maximum contaminant levels allowed in drinking water.

3.2.3 Water Import

As previously stated, the DWA constructed a series of recharge ponds in the upper portion of the Mission Creek Groundwater Sub-Basin but has been able to complete only one cycle of imported water recharge. In 2002, approximately 4,000 AF of water was imported into the basin.

The possibility of future recharge depends largely on the availability of water from the Metropolitan Water District's Colorado River Aqueduct and on agreement with DWA. Depending on the quality of this water, recharge from this source could degrade existing water quality without additional treatment.

A comparison was made to existing water quality to typical Colorado River water quality and is presented in Table 3-2.

Table 3-2
Comparison of Mission Creek Sub-Basin Water Quality with Potential Import
Water from Colorado River System

Constituent	Range	Colorado River Water - Lake Havasu (ave. 1990-1999) ¹	Maximum Potential Increase in Concentration
Total dissolved solids (mg/L)	271-452	637	366
Calcium (mg/L)	35-63.8	76	41
Magnesium (mg/L)	4.9-20.3	28.9	24
Sodium (mg/L)	45.7-68.5	95	49.3
Potassium (mg/L)	2.7-8.8	4.1	1.4
Bicarbonate (mg/L)	131-237	160	29
Sulfate (mg/L)	58-186	258	200
Chloride (mg/L)	15-54.2	83	68
Hardness (mg/L)	110-240	308	198
pH (units)	7.2-8.4	8.25	1.05
Nitrate as NO ₃ (mg/L)	ND-6	0.88	0.83
Iron (mg/L)	ND-0.09	0.3	0.25
Manganese (mg/L)	ND-0.01	0.05	0

¹Source: URS (2000)

The largest potential increases would be associated with TDS, sulfate, and hardness.

3.2.4 Septic Systems

Septic tanks are the secondary method of wastewater disposal in the Mission Creek ground water basin; therefore, septage is a possible source of nitrate (NO₃) to the ground water. Bouwer (1978) reported that nitrogen concentrations in septage can range from 40 to 80 mg/L; mostly in the form of ammonium. If all of the nitrogen was converted to NO₃, then concentrations could range from 177 to 354 mg/L.

Samples of septage from five different septic tanks in Victorville, California, had NO₃ concentrations ranging from 97 to 280 mg/L and averaged 208 mg/L (Umari and others, 1995). Section 3.3 Impacts of Septic Systems contains a more thorough analysis of the types of contaminants often associated with the operation of septic systems.

3.2.5 Undisinfected Secondary Wastewater Percolation

As part of the operation of the Horton WWTP, the plant discharges undisinfected secondary wastewater to evaporation/percolation ponds located adjacent to the WWTP. The plant is permitted to discharge approximately 2.0 mgd of treated wastewater to

percolation ponds that is allowed to infiltrate into the existing groundwater basin. MSWD is required to monitor characteristics of the wastewater as well as groundwater in the uppermost 20 feet of the shallow aquifer underlying the site. The results of this monitoring are reported to the RWQCB at various times throughout the year.

Table 3-3 presents water quality characteristics of the undisinfected secondary wastewater discharged to the percolation ponds for the period September 2003 through August 2004. In general, water quality characteristics maintained a narrow range of values with total dissolved solids indicating the largest fluctuation, ranging from 537-665 mg/L. This fluctuation may be more related to groundwater blending and the resulting water quality changes through the monitoring period. Concentrations of Nitrate as Nitrogen in the wastewater were below the regulatory threshold of 45 mg/L and generally ranged from 10-22 mg/L.

Results of groundwater monitoring adjacent to the ponds suggest that the percolation water that infiltrated had no discernable effect on the general groundwater quality of the shallow groundwater system being monitored. Table 3-4 presents a summary of the water quality from monitoring wells positioned adjacent to the percolation ponds along with the average concentration of wastewater effluent monitored during the same period. In general, the wastewater effluent had similar water quality characteristics as the groundwater being monitored.

3.3 Impacts of Septic Systems

Mission Springs Water District is well respected for the high quality of their groundwater supply. The purpose of this study is to provide basic information concerning septic tank system impacts on groundwater quality in the Mission Creek Sub-Basin (MCSB). Previous studies on MCSB water quality have not provided a comprehensive evaluation of the impacts of local septic systems on the basin. This evaluation will help to answer three questions:

- 1) Where are the general locations of septic discharge?
- 2) What are the quantities of septic discharge? and
- 3) What are the effluent characteristics of septic discharge?

The study also provides an assessment of sources of the available information and what sources should be developed. This information will provide MSWD with the basic information necessary to evaluate the impact to groundwater sources from septic systems and utilize the information to shape future water resource planning policy.

Septic tanks are the secondary method of wastewater disposal in the Mission Creek ground water basin; therefore, septage is a possible source of nitrate (NO_3) to the ground water. Bouwer (1978) reported that nitrogen concentrations in septage can range from 40

TABLE 3-3
SUMMARY OF EFFLUENT WASTEWATER QUALITY -
HORTON WWTP
September 2003 - August 2004

Month/Year	Total Dissolved Solids at 180C (mg/L)	Nitrate as Nitrogen (mg/L)	Total Nitrogen as Nitrogen (mg/L)
September 2003	566	22	22
October 2003	641	20	20
November 2003	542	19	19
December 2003	537	21	21
January 2004	551	21	21
February 2004	657	21	21
March 2004	639	17	17
April 2004	636	18	18
May 2004	642	17	17
June 2004	665	16	16
July 2004	642	10	11
August 2004	609	10	11
Range	537-665	10-22	11-22
Average	611	18	18

SIDS

Monitoring Period	MW-3 (upgradient [a])					
	TDS (b)	Total (b)	NO ₃ as N (b)	SO ₄ (b)	Cl (b)	Al (b)
1st Quarter 2003	694	20	12	220	53	ND
2nd Quarter 2003	699	21	17	220	54	ND
3rd Quarter 2003	672	26	24	240	58	ND
4th Quarter 2003	659	20	22	220	58	ND
1st Quarter 2004	639	22	22	220	56	ND
2nd Quarter 2004	679	20	17	210	54	ND
Average Effluent Wastewater Quality Sepi	---	---	---	---	---	---

Notes:

(a) groundwater flow direction based on w

(b) TDS = Total dissolved solids @180C n

Total N = Total Nitrogen as Nitrogen repor

NO₃ as N = Nitrate as Nitrogen reported in

SO₄ = Sulfate reported in mg/L.

Cl = Chloride reported in mg/L.

Al = Aluminum reported in mg/L.

(c) ND = Not detected.

(d) NR = Not reported.

to 80 mg/L; mostly in the form of ammonium. If all of the nitrogen was converted to NO_3 , then concentrations could range from 177 to 354 mg/L.

Samples of septage from five different septic tanks in Victorville, California, had NO_3 concentrations ranging from 97 to 280 mg/L and averaged 208 mg/L (Umari and others, 1995).

3.3.1 Septic System Inventory

Septic tank wastewater disposal systems have been in use in the study area for three to four decades, and the residency status of the local community has shifted from a primarily resort destination to a community with year-round residents.

There are still more than 5,000 parcels within the study area utilizing individual septic disposal systems overlaying the recharge areas for both the Mission Creek and Desert Hot Springs Sub-Basins. Investigations conducted as part of a USGS study (USGS, 1996) indicate that septic systems in the Desert Hot Springs area are at a density 2.3 to 2.8 times the recommended density (based on local soil conditions) of 0.7 systems per acre.

3.3.2 Quantity and Characteristics of Septic Effluent

A septic tank separates floating and settleable solids (sludge) from wastewater while discharging the clarified wastewater into a drainfield or seepage pit. The sludge that accumulates at the bottom of the septic tank is decomposed by bacteria. The resulting wastewater contains high concentrations of nitrogen, bacteria, and organic carbon. As the wastewater moves through the unsaturated zone, the concentrations of these constituents and thus the severity of groundwater contamination can be greatly affected by physical, chemical, and biological processes.

Septic tank wastewater is known to contain high concentrations (40 to 80 mg/L) of nitrogen, (Bouwer, 1978). As wastewater moves from the septic tank to a drainfield or seepage pit, and subsequently through the underlying unsaturated zone, both concentration and chemical form (speciation) of nitrogen in the wastewater change. The nitrogen species are interrelated by a complicated series of reactions that collectively constitute the nitrogen cycle. This section of the report includes a discussion of some of the more important reactions of the nitrogen cycle, changes in concentrations of the various nitrogen species as wastewater moves from the septic tank through the unsaturated zone, and possible reasons for the observed changes.

Nitrogen Cycle

Because of the importance of nitrogen to the biological cycle, numerous researchers have described the nitrogen cycle in great detail (Bartholomew and Clark, 1965; and National Research Council, 1978, for example). This section of this report emphasizes the

processes of the nitrogen cycle that are important to an understanding of the accumulation of nitrogen and its transformation in wastewater as the wastewater moves from the septic tank through the unsaturated zone.

Nitrogen in septic tank wastewater is predominantly in the form of ammonia (NH_3) and organic nitrogen. (In this discussion, the term "ammonia" is used for the un-ionized form of ammonia [NH_3] and, collectively, for the cationic form [NH_4^+] plus NH_3 when there is no need or intention to distinguish between these forms. "Ammonium" is used specifically to indicate the cationic form.) Under aerobic conditions, organic nitrogen in wastewater is converted to ammonia, which, along with ammonia already present in the wastewater, can be oxidized to nitrate (NO_3^-). The conversion is a two-step biological process known as mineralization.

The first step (conversion of organic nitrogen to ammonia) is referred to as ammonification and can be accomplished both by aerobic bacteria, which exist in the presence of oxygen, and anaerobic bacteria, which exist in the absence of oxygen. The second step (conversion of ammonia to nitrate) is referred to as nitrification and is carried out by several different groups of aerobic microorganisms. Nitrification also is a two-step process: the first group of bacteria, predominantly *Nitrosomonas*, oxidizes ammonia to nitrite (NO_2^-), and the second group, predominantly *Nitrobacter*, oxidize the nitrite to nitrate (National Research Council, 1978, p. 33). Nitrite usually does not accumulate during nitrification because it is oxidized as rapidly as it is formed.

Nitrogen can be removed from wastewater by adsorption and ion exchange, ammonia volatilization, incorporation into cell biomass, plant-root uptake, and denitrification. As wastewater moves through the unsaturated zone, ammonium can be removed by adsorption (including ion exchange) onto soil particles. If the wastewater is sufficiently alkaline (that is, has high pH), some ammonia may be lost to the atmosphere by volatilization of the gas. This process is more likely to occur in the seepage pit than in soil beneath the pit. Organic nitrogen may be immobilized in soils by adsorption and by incorporation into cell biomass as a result of biological activity. Under most soil conditions, nitrogen also is removed by plant-root uptake. However, it is assumed that plant-root uptake is not a significant factor because wastewater is discharged by seepage pits typically below the root zone.

Septic Tank Wastewater

The typical use of water within residences results in an increase in dissolved concentrations of nitrogen and many other chemical constituents in the wastewater. In a study conducted in the Upper Mojave River Basin by Umari and others (1995), they indicated that certain constituents would increase in concentration as compared to the original source (tapwater) notably nitrogen compounds and organic carbon. Table 3-5 presents ranges of increases for selected constituents monitored during the study.

Table 3-5
Calculated Increase in Concentration of Chemical Constituents in Water during Household Use (a)

Constituent	Range of Increase (b)
Specific conductance (µS/cm)	243-1,174
Nitrogen (mg/L)	15-62
Orthophosphate-phosphorus (mg/L)	1.2-18
Organic carbon (mg/L)	10-63
Calcium (mg/L)	2-23
Magnesium (mg/L)	0-6
Sodium (mg/L)	17-178
Potassium (mg/L)	4.9-13
Chloride (mg/L)	9-80
Sulfate (mg/L)	-10-130
Alkalinity as calcium carbonate (mg/L)	97-408
Fluoride (mg/L)	0-.2
Silica (mg/L)	3-16
Boron (µg/L)	-20-1,300
Iron (µg/L)	60-390
Manganese (µg/L)	13-39
Strontium (µg/L)	-20-360
Zinc (µg/L)	<2-50
Lithium (µg/L)	-4-14

a) Source: Umari and others (1995)

b) Based on samples collected from six residential systems.

The largest increases were for sodium, chloride, nitrogen, phosphorus compounds, sulfate and alkalinity. In general, the total nitrogen concentrations increase were the sole result of the septic system use (was not present in tapwater). Almost all the dissolved nitrogen in the septic tank and seepage pit wastewater was in the form of organic nitrogen and ammonia, and little or no nitrate is present in any of the samples. These results are consistent with the absence of oxygen.

Nitrogen Concentrations and Transformations

This section of the report documents changes in nitrogen concentration and the transformation among different species of nitrogen as domestic wastewater moves from the septic tank through the underlying unsaturated zone. In the Mojave study (Umari and others, 1995), Nitrogen concentrations were sampled by use of soil-core extracts and suction lysimeters located at eight study sites. Umari and others (1995) reported that as septic tank effluent is discharged to a new seepage pit, it percolates readily through the base of the pit into the surrounding soil, leaving behind only a small quantity of

wastewater in the seepage pit. However, after operation of the disposal system for a period of time, microbial activity in the anaerobic environment that prevails in the wastewater quickly results in biological clogging of the cinder blocks and soil immediately adjacent to the pit's wall (Stewart and others, 1979, and references therein). Progressive clogging causes the wastewater level to rise in the seepage pit until it reaches a zone of sufficiently high permeability that it can't be sealed by microbial activity, and most of the wastewater then percolates through the rapid flow pathway at this level (Sinton, 1986) and is referred to as the active discharge level of the seepage pit. This active discharge level ranges from the bottom of the seepage pit at new residences and varies depending on the type of septic system (pit or drain field) and whether the site is new or old. The unsaturated zone above the active discharge level is unaffected by septic tank wastewater.

Umari and others (1995) reported that with the exception of only a few samples collected directly beneath the seepage pits, dissolved nitrogen in the unsaturated zone is almost entirely in the form of nitrate. This suggests that reduced nitrogen (ammonia and organic nitrogen) present in the septic tank wastewater is rapidly nitrified by microorganisms in soil near the seepage pit.

Umari and others (1995) also indicated that as the septic tank wastewater moves from the seepage pit through the unsaturated zone, nitrification seems to continue, at least for some depth, as indicated by some increase in nitrate concentration with increasing depth. However, Umari and others (1995) reported that this trend is suddenly reversed above the water table. Nitrate as N concentrations decreased to less than 10 mg/L in both soil-core and suction lysimeter samples.

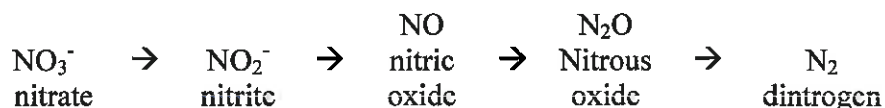
Umari and others (1995) suggested three explanations for the observed decrease in nitrate concentration:

1. microbial nitrate reduction (denitrification)
2. mixing of the wastewater with low nitrate ground water in the capillary fringe, and
3. the wastewater wetting front has reached the water table, but the actual wastewater has yet to arrive.

Denitrification

Umari and others (1995) suggested that denitrification may be partly responsible for the decrease in nitrate concentration as wastewater moves through the unsaturated zone in the study area. Umari and others (1995) reported that standard plate counts exhibited an abundance of aerobic, heterotrophic bacteria in the unsaturated zone. As long as molecular oxygen is present, the bacteria will use it as a terminal electron acceptor. In the absence of oxygen, a large and diverse group of nitrate-respiring heterotrophs, including *Pseudomonas*, can use nitrogen instead of oxygen as the terminal electron acceptor.

The pathway for denitrification can be represented by a series of steps as follows:



The multiple steps in this process are carried out by separate bacteria, and denitrification refers only to those later steps that produce the gaseous end products (NO , N_2O , and N_2); however, the term denitrification commonly is loosely applied to the entire process of nitrate reduction, except when the end product is ammonia. Although there are nitrate-respiring microorganisms capable of reducing nitrate to ammonia, groundwater studies in other areas suggest that this reaction is either unlikely or of very minor importance. Smith and Duff (1988) initially reported denitrification only, with no evidence of dissimilatory nitrate reduction to ammonia, in a shallow sand and gravel aquifer in Cape Cod, Massachusetts. There, the aquifer was contaminated by secondary treated wastewater in which nitrate-N was 13 mg/L and organic carbon was 12 mg/L. Subsequent studies on dissolved ammonia in the same aquifer confirmed dissimilatory nitrate reduction but concluded that it seemed to be only a minor sink for nitrate (Smith and others, 1991). At low organic carbon-to-nitrate ratios, denitrification is favored over dissimilatory nitrate reduction to ammonia (Tiedje and others, 1982).

Total Bacteria and Fecal Coliforms

Wastewater contains a wide variety of pathogenic bacteria, viruses, protozoa, and worms. One published average biological characteristic for domestic wastewater is: total bacteria = $5.6\text{--}8 \times 10^7$ CFU (colony-forming units)/100 mL, total coliform = 2×10^6 MPN/100 mL, fecal coliform and fecal streptococci = 3×10^4 MPN/100 mL, and enteric viruses = 32–7,000 PFU (plaque-forming colonies)/L (Viraraghavan, 1976, and Siegrist, 1977). Other values for average total bacteria and fecal coliform densities that exceed the above values by a factor of about 10 also have been reported (Siegrist, 1977; Canter and Knox, 1985). Umari and others (1995) reported measured ranges of 1.2×10^8 to 9.4×10^8 CFU/100 mL for total (heterotrophic) bacteria and 5.2×10^4 to 3.9×10^5 CFU/100 mL for fecal coliform in wastewater collected at five residences in the Upper Mojave study area.

Umari and others reported the disappearance of fecal coliforms from soils only a short distance from the seepage pits in the Upper Mojave study area and suggested that other pathogenic microorganisms also would be unlikely to reach the water table given the long distance and travel times.

Physical straining (filtration) and adsorption (Canter and Knox, 1985) probably are the most important mechanisms of fecal coliform removal in the soils at the Mission Creek Sub-Basin. Additional factors that might favor rapid attenuation are competition with native bacteria for nutrients, antagonism from actinomycetes and other groups of bacteria such as *Pseudomonas* and *Bacillus* (Matthess and others, 1988), and an unsaturated (as opposed to saturated) flow regime below the seepage pits (Hagedorn and others, 1978, and Reneau, 1978).

Other Contaminants in Wastewater

Beginning about 1980, it was recognized that synthetic organic chemicals might exist in septic tank effluent, and a few analyses have been done (Viraraghavan and Hashem, 1986, and references therein). Volatile (or purgeable) priority pollutants, which are commonly used solvents, and acid-extractable priority pollutants, such as phenols, have chemical properties that are favorable for their transport, making them the trace organic constituents of greatest concern (Viraraghavan and Hashem, 1986). Umari & others (1995) detected 17 out of 85 priority pollutants analyzed; however, their concentrations were generally low with a few exceptions. One particular site exhibited high concentrations of toluene (350 µg/L) and tetrachloroethylene (260 µg/L) that they attributed in improper disposal practices. In addition, Umari & others (1995) indicated that several nonspecific acids and alcohols that probably are microbial degradation products of precursors commonly present in domestic wastewater were also found and ranged from 40-1,200 µg/L.

It is likely that, in general, the synthetic organic chemical concentrations in domestic wastewater are low, as was reported by Viraraghavan and Hashem (1986).

3.3.3 Potential for Groundwater Contamination

As stated previously, there were more than 5,500 septic tank systems in use in the study area in 2004. Wastewater discharge from these systems that would recharge the underlying groundwater system was estimated to be 341 acre-ft/yr, equal to about 2.2% percent of the total inflow to the Mission Creek Sub-Basin. Because of the high concentrations of nitrogen and bacteria in septic tank wastewater, recharge of the wastewater would be expected to degrade the quality of the underlying ground water.

Umari & others (1995) indicated that nitrogen and bacteria are attenuated in the unsaturated zone. Umari and others (1995) subsequent investigations in groundwater downgradient from a septic tank wastewater input point did not show any appreciable increase in nitrate concentration in a downgradient direction. The data suggested either (1) a substantial fraction of the nitrogen in septic tank wastewater is being removed in the unsaturated zone or in the saturated zone near the water table; (2) substantial dilution is occurring over a thick saturated zone; (3) the quantity of wastewater is small in comparison with the quantity of underlying ground water; or (4) the wastewater has not yet reached the water table near the monitoring sites.

In contrast, Nishikawa and others (2003) reported that from early 1995 through 2001, nitrate (NO₃) concentrations in ground water in the Warren Sub-Basin, Yucca Valley, California, increased from a background concentration of 10 milligrams per liter (mg/L) to more than the U.S. Environmental Protection Agency (USEPA) water quality maximum contaminant level of 44 mg/L (10 mg/L as nitrogen). This increase coincided with an artificial groundwater recharge program implemented by the local water district,

Hi-Desert Water District (HDWD), to reverse ground water level declines of as much as 300 ft. Findings from the study suggested the following:

- Septage from septic tanks was the primary source of NO_3 to the ground water system.
- Rising groundwater levels, resulting from the artificial recharge program, entrained high NO_3 septage stored in the unsaturated zone.
- The potential for groundwater contamination should be evaluated before beginning an artificial recharge program in an area that uses septic tanks.

Thus, as ground water levels declined and residential development increased, septic systems impacted more and more of the increasingly deeper unsaturated zone. While the distance to the water table was sufficient to remove most of the nitrate (through denitrification) from the septage before entering the underlying groundwater, the upper parts of the unsaturated zone still contained significant quantities of nitrate adsorbed to the soil particles. Consequently, as the groundwater table rose due to recharge, the nitrate that was attached to the soil particles was solubilized and impacted the ground water quality causing high nitrate concentrations in wells.

3.3.3 Impact on Basin Groundwater Quality

At the present time, there is insufficient information to assess what effect, if any, that the use of septic systems have had on the existing water quality in the Mission Creek Sub-Basin. Based on studies conducted in similar areas (Upper Mojave), it is unlikely that the septic systems have had a significant impact on ground water quality.

However, it is likely that with the implementation of a program to recharge groundwater such that a significant short term rise in ground-water levels occurs in areas where septic systems were or are presently in use, ground-water quality might be severely impacted from residual nitrate stored in the unsaturated zone similar to what may have occurred in the Warren Basin near Yucca Valley.

Moreover, the United States Department of the Interior, US. Geological Survey, stated in a letter report to the MSWD dated June 17, 1996, the following:

"In 1995, there were about 5,230 septic tank systems in the city of Desert Hot Springs and surrounding communities. Contamination of groundwater resulting from the increasing quantity of wastewater discharge into the unsaturated zone is a major concern to the District. The underlying alluvial aquifer on the west side of the city of Desert Hot Springs is the sole source of public water supply and alternate sources of water are not available. Wastewater contains contaminants, such as nitrogen, bacteria, and organic chemicals that may degrade the quality of ground water and render it unsuitable for potable consumption. Because the Mission Creek Sub-Basin is a sole source aquifer for Desert Hot Springs and

surrounding communities, it is prudent to determine the potential for groundwater contamination from septic tank wastewater."

3.3.4 Conclusions and Recommendations

The continued operation of septic systems may pose a threat to the Sub-Basin groundwater quality through several avenues such as:

- Pathway for the introduction of septage, specifically nitrogen compounds and bacteriological components into the unsaturated zone and to a lesser degree, the existing ground water;
- Pathway for the introduction of other constituents that degrade the existing water quality including but not limited to sodium, chloride, boron, phosphates, and other deleterious compounds;
- Pathway for the illegal disposal of household hazardous waste including but not limited to oils, grease, paints, solvents, pesticides, and other deleterious compounds.

Recommendations for future activities/action include:

- Make an assessment of the high value areas on the Sub-Basin (basically where ground water pumpage is greatest and or recharge is likely);
- Initialize a program to "phase-out" new septic tanks in these areas by prioritizing these areas for sewer hook-up;
- Initiate a education program for non-sewered areas to educate families/household on what is/is not allowed disposed of in a septic tank;
- Conduct annual inspections of any commercial/industrial establishment that is listed as a small quantity generator and operates a septic system to reduce the possibility that chemicals/hazardous wastes are being disposed of in the septic system.

4.0 GROUNDWATER MONITORING PROGRAM

A Groundwater Monitoring Program provides the necessary information to assess if the groundwater management goals and objectives are being met. The following discussion is based upon PSOMAS' current understanding of the existing monitoring program along with a conceptualization of the types of information that would be required as part of a future groundwater monitoring program.

4.1 Existing Groundwater Monitoring Program

An interim monitoring program appears to be present in the MSWD service area. However, the extent of the program, the goals and ultimate use is not well defined. Depth to groundwater is collected in selected active wells, inactive wells, and some private wells. Generally, these measurements are collected on a monthly basis.

Groundwater quality information is collected on all active wells are part of the Title 22 reporting requirements for municipal water supply purveyors.

4.2 Recommended Groundwater Monitoring Program

A future groundwater monitoring program should place emphasis on three major goals for groundwater management:

1. First the protection and efficient operation of existing municipal water supply wells. This goal would include the use of collected data for planning and siting of future production wells.
2. The second major goal is to monitor continuing changes in storage of the groundwater volume in the Sub-Basin due to pumping in order to monitor overdraft and potentially implement programs that would mitigate storage loss through conservation, recharge, or alternative uses.
3. The third major goal would be to monitor groundwater quality and track any changes in water quality due to future groundwater recharge activities, waste water percolation ponds, or man-made contamination.

A monitoring network of wells needs to be determined and can be based on the data collected during the recent groundwater level survey PSOMAS performed in June of 2004. The wells in the monitoring network should include municipal wells, private domestic wells, and other private wells such as golf courses or resorts. By using as many types of wells as possible a greater geographic area of the Sub-Basin can be monitored. These water levels will address the data gaps and become a nucleus for a groundwater level database along with already existing groundwater level data.

By collecting and analyzing data in these data deficient areas of the Sub-Basin, previous potentiometric surface maps such as Fox (1992) and Slade (2000), the PSOMAS (2004) groundwater level map can be updated regularly using a GIS. Analysis of the new potentiometric surface map will assist in defining the occurrence, change in storage, and movement of groundwater in the basin with respect to manmade and natural activities.

The boundaries of the monitoring well network should be defined by wells that reside as close to Sub-Basin boundaries as possible, as well as residing in the Sub-Basin interior area where present data gaps occur. The monitoring well network will be stored in a GIS which allows flexibility and efficient analysis of groundwater data.

4.2.1 Groundwater Levels

Collection of groundwater levels from the monitoring network should be conducted on a quarterly basis during the initial years of the monitoring program. Quarterly data will allow more data to be collected and analyzed and allow better quality control of the data with respect to anomalies or trend spotting. This in turn will allow quicker turnaround for the calculation of changes in storage within the Sub-Basin and allow quicker response to remedial actions in the event Groundwater Management goals and objectives are threatened.

Monitoring well locations will be defined using the Township / Range / Section system. The California Dept. of Water Resources (DWR) uses this system when establishing a well's State Well Number (SWN). Therefore the monitoring wells' data should be stored in the database using this DWR approved method. This will allow the data to be cross referenced in other databases that use this standard system. It will also help when communicating with agencies such as DWR during funding requests or other formal business.

4.2.2 Groundwater Quality

Along with groundwater levels, groundwater quality data should be collected. Not all wells in the monitoring network need be sampled for water quality. Selected wells based on certain criteria such as; proximity to known water quality zones, contaminated areas, groundwater recharge areas, zones of high pumping, or areas where recycled water is being used should be considered. These water quality data should not be confused with regular Title 22 sampling for compliance of the municipal water supply wells.

Semi-annual water quality constituents that should be collected will include major ions including nitrate. A list of recommended constituents follows:

1. Major Ions (Cations and Anions):
 - a. Calcium
 - b. Magnesium
 - c. Sodium
 - d. Potassium
 - e. Sulfate
 - f. Chloride
 - g. Fluoride
 - h. Nitrate
 - i. Bicarbonate (HCO_3)
2. A typical general physical suite of analytes will include:
 - a. Total Dissolved Solids (TDS)
 - b. Specific Conductance
 - c. Turbidity
 - d. Color
 - e. Odor
 - f. pH

Annual water quality constituents that should be collected will include the constituents listed above and the following:

1. Metals
 - a. Copper
 - b. Iron
 - c. Manganese
2. Other Compounds
 - a. Boron
 - b. Volatile Organic Compounds (VOCs)
 - c. Methyl Blue Active Substances (MBAS)

These water quality data should be entered into a water quality database that is connected to the groundwater monitoring network GIS for data storage, analysis, and display.

4.3 Recommendations

A proper groundwater monitoring plan is part of a larger Groundwater Management Plan that set forth goals, specific ways to monitor these goals and actions to be taken in the event these goals are threatened.

A Groundwater Management Plan should be developed that incorporates the following elements:

- a) Technical goals to control and monitor groundwater supply within MWSD's sphere of influence:

necessary information to assess if the Groundwater Management Goals and Objectives are being met.

5.0 QUANTIFICATION OF RECYCLED WATER IN THE BASIN

The California Water Code defines recycled water as “water which, as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and is therefore considered a valuable resource.” Water recycling allows water managers to match water quality to specific reuse applications. This reduces the amount of fresh water required for non-potable uses, ensuring that the highest quality of water will be reserved for the most important use...public drinking water.

For many communities, an investment in recycled water solves many problems, simultaneously. It may solve a difficult pollution control problem, forestall a severe water shortage or provide drought protection. In addition, it may offset the need to purchase additional water from an external supplier.

To better quantify the availability of recycled water in the basin and some of the potential uses, Psomas has organized this part of the report into the following sub-sections:

- Identification of Recycled Water - describes the current availability of recycled water;
- Potential Future Gains/Losses/Redistribution of Recycled Water – describes the changes to the availability of recycled water due to future changes in treatment plants and/or addition/deletions due to reconfiguration of the existing treatment plants;
- Potential Uses and Associated Costs for Recycled Water Use – describes the potential uses and associated costs for reuse of recycled water.

5.1 *Identification of Recycled Water and Potential Uses*

For the most part, the availability of recycled water in the Mission Creek Sub-Basin is limited to water generated as part of the wastewater treatment associated with sewage collected from sewer residential developments, commercial and industrial properties.

According to California State Regulations, Title 22, Chapter 3 Water Recycling Criteria, the available recycled water can fall into one of four categories as follows:

Undisinfected Secondary Recycled Water – is “oxidized” wastewater.

Disinfected Secondary-23 Recycled Water – is wastewater that has been oxidized and disinfected so that the median concentration of total coliform bacteria in the disinfected effluent does not exceed a most probable number (MPN) of 23 per 100 milliliters utilizing the bacteriological results of the last seven days for which analyses have been completed, and the number of total coliform bacteria does not

exceed a MPN of 240 per 100 milliliters in more than 1 sample in any 30-day period.

Disinfected Secondary-2.2 Recycled Water – is wastewater that has been oxidized and disinfected so that the median concentration of total coliform bacteria in the disinfected effluent does not exceed a MPN of 2.2 per 100 milliliters utilizing the bacteriological results of the last seven days for which analyses have been completed, and the number of total coliform bacteria does not exceed an MPN of 23 per 100 milliliters in more than 1 sample in any 30-day period.

Disinfected Tertiary Recycled Water – is a filtered and subsequently disinfected wastewater that has been disinfected by one of the following methods: 1) a chlorine disinfection process following filtration that provides a CT value of not less than 450 milligram-minutes per liter at all times with a modal contact time of at least 90 minutes, based on peak weather design flow; or 2) a disinfection process that, when combined with the filtration process, has been demonstrated to inactivate and/or remove 99.999 percent of the plaque-forming units of F-specific bacteriophage MS-2, or polio virus in the wastewater.

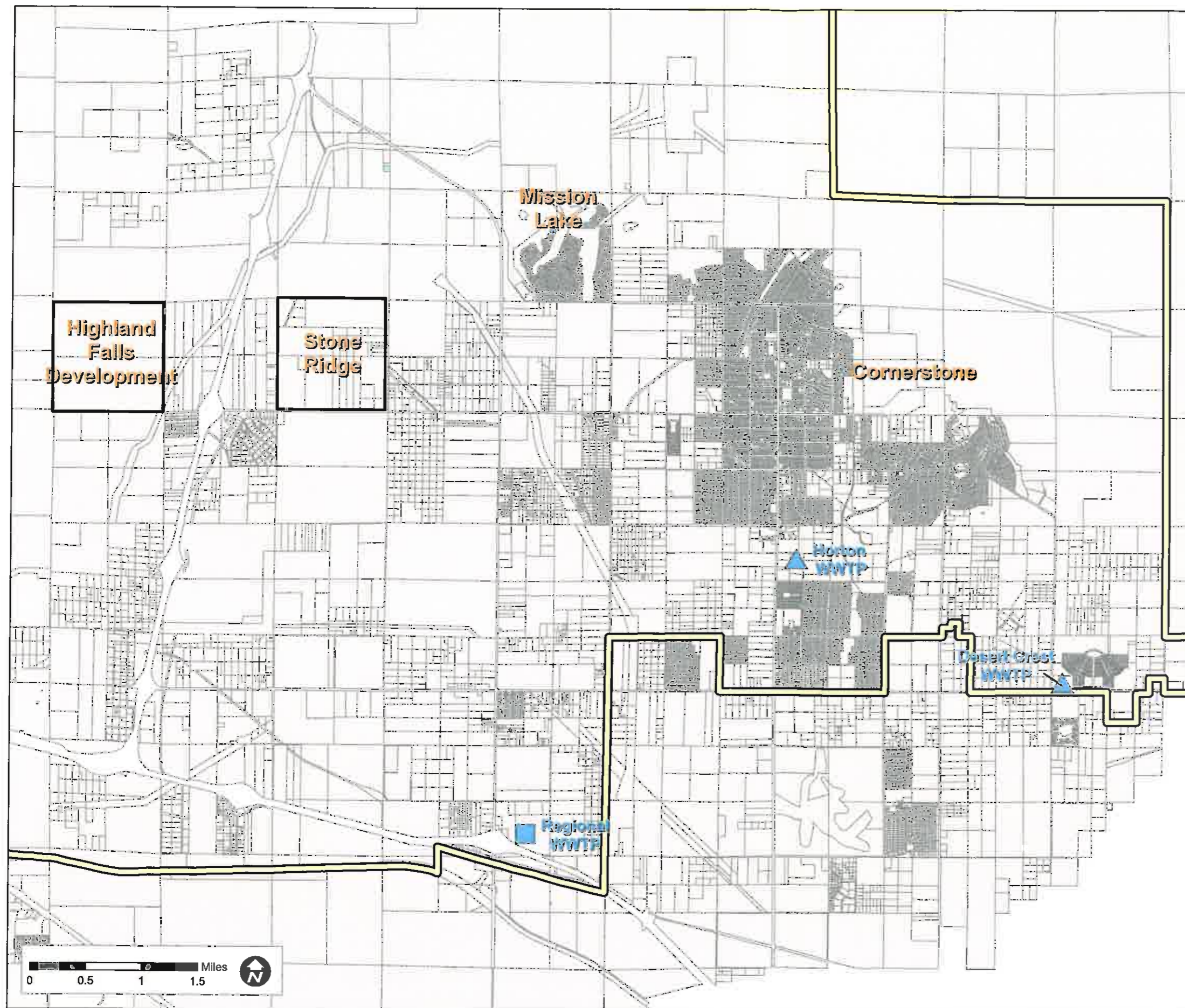
5.1.1 Existing Wastewater Treatment Systems and Components

The following discussion is based largely on the Master Sewer Plan prepared by Albert A. Webb Associates (2001) and referred to as the MSP.

Treatment Facilities

The MSWD operates two wastewater treatment plants serving a population of approximately 3,900 residential and 243 commercial connections (MSWD, 2004). The Alan L. Horton Wastewater Treatment Plant (Horton WWTP), located on Verbena Drive about ½ mile south of Two Bunch Palms Trail (Figure 5-1), has a capacity of 2.5 million gallons per day (mgd). The Horton WWTP facility uses an extended aeration process for treatment and disposes of the undisinfected secondary wastewater in adjacent percolation/evaporation ponds. The sludge generated from the treatment process is dried in on-site beds and then trucked offsite to proper disposal areas.

The Desert Crest Wastewater Treatment Plant, located about ½ mile southeast of the intersection of Dillion Road and Long Canyon Road, has a capacity of 0.18 mgd and serves a country club development and mobile home park. This treatment facility is operating with an average daily flow of 0.05 mgd. The facility operates similar to the Horton WWTP using an aeration basin for treatment and disposes of the undisinfected secondary wastewater by way of percolation/evaporation ponds. The sludge generated from the treatment process is dried in on-site beds and then trucked offsite to proper disposal areas.



Legend

- MSWD Service Area Boundary
- ▲ Existing WWTP
- Proposed WWTP

**Location of Various Wastewater
Treatment Facilities -
Existing and Proposed**

Pipeline System

The existing wastewater conveyance system consists of a network of nearly 45 miles of sewer pipeline concentrated in the central portion of the study area where the majority of the populace and businesses reside. The Desert Crest Country Club community first received sewer service in the early 1960s with the outlying tracts established later in the early 1970s. Most of the MSWD sewer pipelines were constructed in the early 1970s and include lines along Ocotillo Road, Palm Drive, and Mission Lakes Boulevard. In the early 1980s, improvements to the pipeline system were added to tracts west of West Drive.

There is an ongoing program to incorporate existing residences currently on septic systems to sewer collectors that have been constructed or are in the process of being constructed.

MSWD Assessment Districts

As part of the ongoing conversion process from septic tanks to the wastewater treatment system available in the Mission Creek Sub-Basin, MSWD has implemented a program to install infrastructure (pipelines and pump stations) and connect current septic tank users to a septic pipe system that connects up these users with the Horton WWTP. This process was enacted as part of improvement bonds approved by the voters in the Desert Hot Springs area. MSWD has created Assessment Districts that designate specific improvements with specific parcels in the Desert Hot Springs area. Specifically Assessment District (AD) 11 was created from a measure approved by the voters in June 2000 and included improvements for 1232 parcels. AD12 was created from a measure approved by voters in June 2004 and included improvements for 6788 parcels (MSWD, 2004).

Sewage Pump Station

There is one existing sewage pump station located near the intersection of Avenida Manzana and Camino Campesino, which services the area south of the Horton WWTP. An existing 6-inch diameter force main sewer traverses from the sewer pump station along Avenida Manzana and discharges into the Horton WWTP. The sewage pump station consists of a 96-inch diameter manhole with two submersible pumping units that are 7½ Horsepower (HP) each and pump 150 gallons per minute (gpm). A valve vault and electrical panel complete the installation. Backup electrical power to the pump station is provided by way of a portable diesel generator which is stored at the Horton WWTP.

The sewage pump station was built in 1987. Site investigations and interviews with District staff indicate the facility is currently operating in good operating condition, and failures have not yet been recorded.

5.1.2 Potential Uses of Recycled Water

Potential uses of recycled water have been well documented and continue to be developed based on specific community needs and programs. For the most part, the types of uses can be divided into five major categories that include:

- Groundwater Recharge
- Surface Irrigation
- Impoundments
- Cooling
- Other Uses

The California Department of Health Services (DHS) sets treatment/water quality requirements for recycled water depending on its end use. Table 5-1 presents a summary of the various types of uses and what is allowed/disallowed depending on the quality or type of recycled wastewater.

5.2 Potential Future Gains/Losses/Redistribution of Recycled Water

Since the availability and distribution of recycled water is directly dependent on the projected requirements for wastewater disposal in the MSWD service area, an evaluation was conducted on what the projected requirements for wastewater treatment plants, and sewer collection systems including pipelines and pump stations. The wastewater treatment requirements were divided into two scenarios:

- 1) Near-term requirements – is the expected wastewater (including current demand) that would be generated during the next five-year period (Year 2005 through Year 2009). The following assumptions were used:
 - a) Existing sewerage areas are assumed to total 4,000 equivalent dwelling units (EDUs);
 - b) New development (exclusive of septic conversions) is estimated at 1,000 EDUs in 2005 and 1,300 EDUs per year from 2006 through 2009;
 - c) Assessment District (AD) 11 has residences on septic systems and expected to add 650 EDUs in 2005;
 - d) AD 12 is expected to add 1,000 EDUs per year to the existing residential service between 2005 through 2009.

- 2) Full build out – is based on the MSP.

The development of the following information is based on discussions with MSWD staff as well as work documented in the MSP.

TABLE 5-1
POTENTIAL USES OF RECYCLED WATER AND REQUIRED TREATMENT
LEVELS¹

Uses of Recycled Water		Treatment Levels			
		Disinfected Tertiary Recycled Water	Disinfected Secondary-2.2 Recycled Water	Disinfected Secondary-23 Recycled Water	Undisinfected Secondary Recycled Water
Groundwater recharge as part of a Groundwater Recharge Reuse Project (GRRP)		Allowed under special case-by-case permits by Regional Water Quality Control Boards ²			
Surface Irrigation	Food crops, including edible root crops	Allowed	Not allowed	Not allowed	Not allowed
	Parks & Playgrounds	Allowed	Not allowed	Not allowed	Not allowed
	School Yards	Allowed	Not allowed	Not allowed	Not allowed
	Residential Landscaping	Allowed	Not allowed	Not allowed	Not allowed
	Unrestricted golf courses	Allowed	Not allowed	Not allowed	Not allowed
	Food crops where edible portion is above ground and not contacted by recycled water	Allowed	Allowed	Not allowed	Not allowed
	Cemeteries	Allowed	Allowed	Allowed	Not allowed
	Freeway Landscaping	Allowed	Allowed	Allowed	Not allowed
	Restricted Access golf courses	Allowed	Allowed	Allowed	Not allowed
	Ornamental nursery stock & sod farms	Allowed	Allowed	Allowed	Not allowed
	Pasture animals producing milk for human consumption	Allowed	Allowed	Allowed	Not allowed
	Any non-edible vegetation where access is controlled	Allowed	Allowed	Allowed	Not allowed
	Orchards - no contact with edible portion of crop	Allowed	Allowed	Allowed	Allowed
	Vineyards - no contact with edible portion of crop	Allowed	Allowed	Allowed	Allowed
	Non food-bearing trees	Allowed	Allowed	Allowed	Allowed
	Fodder and fiber crops and pasture for animals not producing milk for human consumption	Allowed	Allowed	Allowed	Allowed
	seed crops not eaten by humans	Allowed	Allowed	Allowed	Allowed
	Food crops that undergo pathogen-destroying process before human consumption	Allowed	Allowed	Allowed	Allowed
Impoundments	Non-restricted recreational impoundments	Allowed	Not allowed	Not allowed	Not allowed
	Restricted recreational impoundments	Allowed	Not allowed	Not allowed	Not allowed
	Publicly accessible impoundments at fish hatcheries	Allowed	Allowed	Not allowed	Not allowed
	Landscape impoundments - no decorative fountains	Allowed	Allowed	Allowed	Not allowed

TABLE 5-1
POTENTIAL USES OF RECYCLED WATER AND REQUIRED TREATMENT
LEVELS¹

Uses of Recycled Water		Treatment Levels			
		Disinfected Tertiary Recycled Water	Disinfected Secondary-2.2 Recycled Water	Disinfected Secondary-23 Recycled Water	Undisinfected Secondary Recycled Water
Cooling	Industrial or commercial cooling/air conditioning that uses cooling tower, evap. cond., spraying or any mist	Allowed	Not allowed	Not allowed	Not allowed
	Industrial or commercial cooling/air conditioning that does not use cooling tower, evap. cond., spraying or any mist	Allowed	Allowed	Allowed	Not allowed
Other Uses	Flushing toilets and urinals	Allowed	Not allowed	Not allowed	Not allowed
	Priming drain traps	Allowed	Not allowed	Not allowed	Not allowed
	Industrial process water that may contact workers	Allowed	Not allowed	Not allowed	Not allowed
	Structural fire fighting	Allowed	Not allowed	Not allowed	Not allowed
	Decorative fountains	Allowed	Not allowed	Not allowed	Not allowed
	Commercial laundries	Allowed	Not allowed	Not allowed	Not allowed
	Consolidation of backfill material around potable water pipelines	Allowed	Not allowed	Not allowed	Not allowed
	Artificial snow making for commercial outdoor uses	Allowed	Not allowed	Not allowed	Not allowed
	Commercial car washes not done by hand & excluding the general public from washing process	Allowed	Not allowed	Not allowed	Not allowed
	Industrial boiler feed	Allowed	Allowed	Allowed	Not allowed
	Nonstructural fire fighting	Allowed	Allowed	Allowed	Not allowed
	Backfill consolidation around nonpotable piping	Allowed	Allowed	Allowed	Not allowed
	Soil compaction	Allowed	Allowed	Allowed	Not allowed
	Mixing concrete	Allowed	Allowed	Allowed	Not allowed
	Dust control on roads and streets	Allowed	Allowed	Allowed	Not allowed
	Cleaning roads, sidewalks and outdoor work areas	Allowed	Allowed	Allowed	Not allowed
	Flushing sanitary sewers	Allowed	Allowed	Allowed	Allowed

Notes:

¹ Refer to the full text of the latest version of Title-22: California Water Recycling Criteria.

² Refer to Groundwater Recharge Guidelines, California Department of Health Services.

5.2.1 Treatment Plants

Near-Term Wastewater Treatment Requirements (Year 2005-2009)

An assessment was conducted of the expected wastewater that would be generated for each year for the period 2005 through 2009 using the assumptions listed above. Using a daily wastewater generation value of 250 gallons/EDU, the wastewater generated would rise from a current 1.0 mgd to nearly 4.0 mgd in Year 2009. Table 5-2 presents the projected wastewater generation by year for the various components in the MSWD area.

The treatment capacity would need to rise from a current 2.5 mgd to an estimated requirement of 4.0 mgd in Year 2009. A graph of the anticipated yearly wastewater generation versus existing WWTP capacity is presented in Figure 5-2.

Full Build Out Requirements

The MSP developed a full build out scenario assuming that the total available acreage was developed and that the wastewater generated was based upon the corresponding land uses of the acreage. The MSP indicated that in addition to the two existing wastewater treatment plants, two other plants would be required and were identified as: 1) a future regional wastewater treatment plant site referred to as the Regional WWTP, and 2) a site downstream of the Highland Falls and Stone Ridge Golf Course Specific Plans referred to as the Rancho Royale WWTP. Currently, Rancho Royal WWTP is no longer a conceptual project and projected design flows have been incorporated into the Horton WWTP.

Based on these assumptions, the MSP developed total average daily flows for each existing and proposed WWTP as presented in Table 5-3.

Table 5-3
Projected Wastewater Treatment Capacity at Full Build Out

Name of WWTP	Existing or Future	Design Flow Q _{ADE} (mgd)
Horton WWTP	Existing	9.9
Desert Crest WWTP	Existing	0.6
Regional WWTP	Future	14.7
TOTAL		25.2

Consequently, the total projected wastewater generation under maximum average daily design flow for a full build out scenario would be 25.2 mgd or 28,228 acre-feet/year.

TABLE 5-2
PROJECTED WASTEWATER GENERATION IN MISSION SPRINGS WATER
DISTRICT
YEARS 2005-2009

COMPONENT	EXISTING	YEAR/INCREASE					TOTAL
		2005	2006	2007	2008	2009	
Existing Sewered Areas + Growth							
EDUs	4,000	1,000	1,300	1,300	1,300	1,300	10,200
Flow (gpd)	1,000,000	250,000	325,000	325,000	325,000	325,000	2,550,000
AD11 (under constr.)							
EDUs		650					650
Flow (gpd)		162,500					162,500
AD12							
EDUs		1,000	1,000	1,000	1,000	1,000	5,000
Flow (gpd)		250,000	250,000	250,000	250,000	250,000	1,250,000
TOTAL							
EDUs	4,000	2,650	2,300	2,300	2,300	2,300	15,850
Flow (gpd)	1,000,000	662,500	575,000	575,000	575,000	575,000	3,962,500
Total Cumulative Flow (gpd)	1,000,000	1,662,500	2,237,500	2,812,500	3,387,500	3,962,500	3,962,500
TREATMENT CAPACITY existing & proposed (gpd)							
	2,500,000	2,500,000	2,500,000	5,000,000	5,000,000	5,000,000	

PROJECTION OF WASTEWATER GENERATION - MSWD

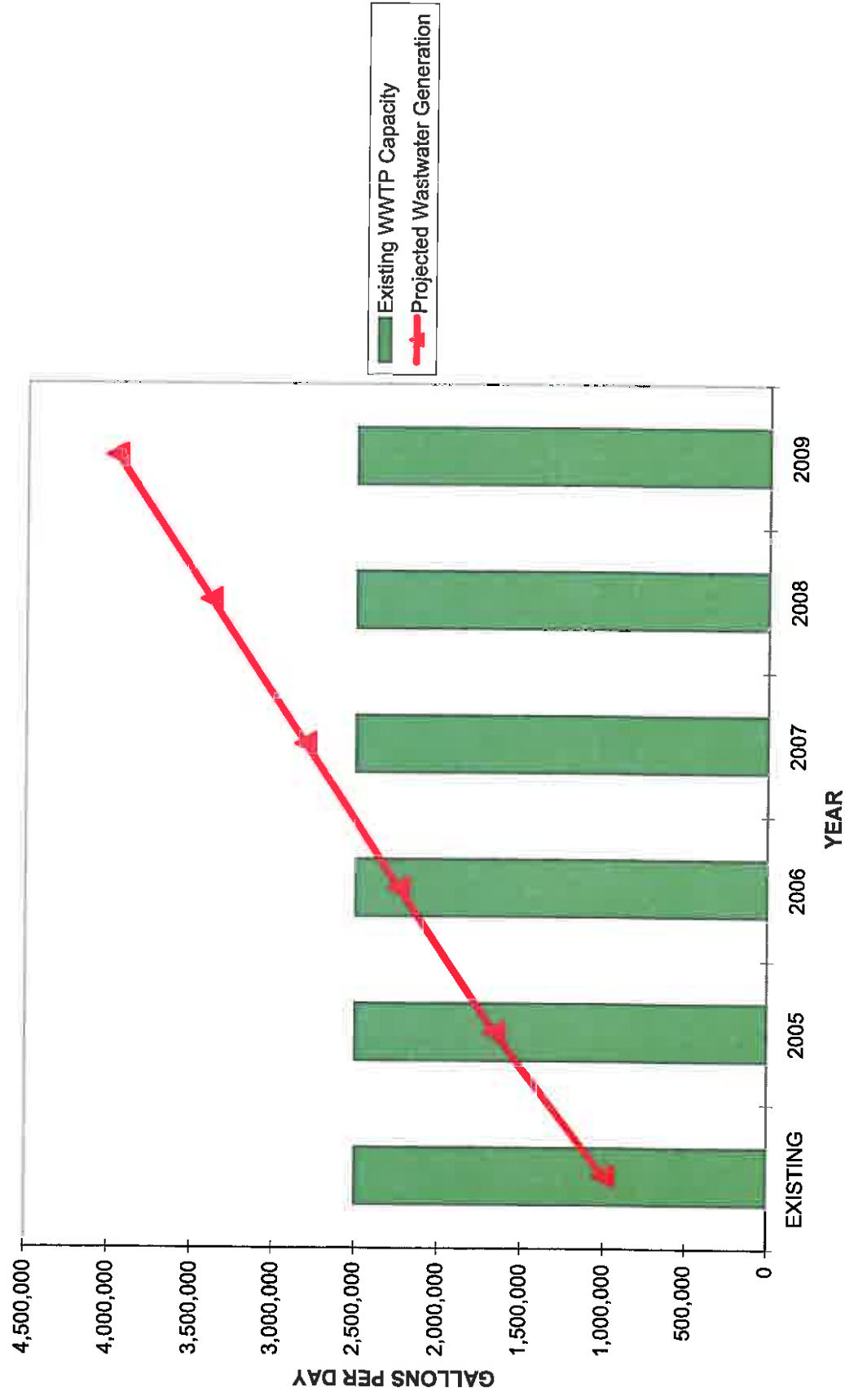


FIGURE 5-2

5.2.2 Distribution System

Configuration and costs associated with a recycled water distribution system is separated into two scenarios:

- Near-Term Recycled Water Distribution Requirements
- Full Build Out

Near-term is assumed to be the next 5-year period where as the full build out is based on full build out of the area as described in the MSP.

Near-Term Recycled Water Distribution Requirements (Year 2005-2009)

In order to assess the requirements for various distribution systems for the recycled water, it was assumed that only two types of planned uses would be considered:

- percolation ponds for groundwater recharge in areas where no current or historical septic systems were in use; and
- irrigation of large, mostly turf areas associated with golf courses, parks, and/or schools.

The following scenarios were used to project associated requirements for the proposed recycled water distribution systems including pipelines and pump stations:

Scenario 1 – a distribution system that includes a pipeline from the Horton WWTP to Mission Lakes Golf Course

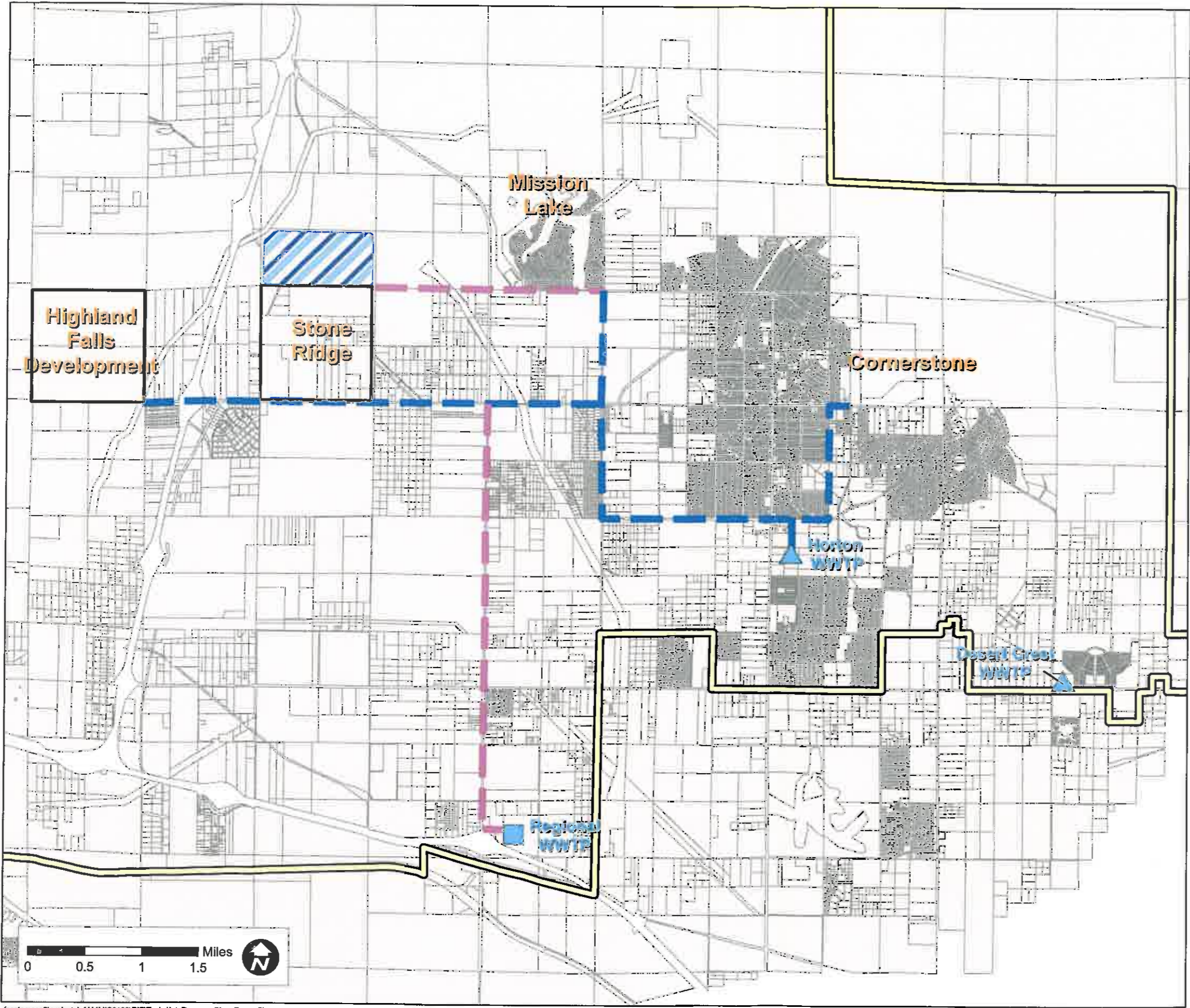
Scenario 2 – distribution system that includes a pipeline from the Horton WWTP to the proposed Highland Falls Golf Course

Scenario 3 - distribution system that includes a pipeline from the Horton WWTP to the proposed Cornerstone Golf Course

Scenario 4 - distribution system that includes a pipeline from the Horton WWTP to proposed new percolation ponds located west of Mission Lakes Golf Course

Figure 5-3 shows the preliminary routing of pipelines to the end point uses planned for each of the scenarios described above. A final routing would have to be developed in consultation with MSWD including engineering and environmental review.

The Mission Lakes Golf Course uses approximately 2,000 acre-feet/year of potable water to maintain the turf associated with the golf course. While specific water requirements have not been finalized for the proposed golf courses at Highland Falls and Cornerstone



Legend

- MSWD Service Area Boundary
- Proposed Recycled Water Pipeline**
 - Initial Piping (Near-Term Buildout)
 - Additional Piping (Full-Term Buildout)
- Existing WWTP
- Proposed WWTP
- Proposed Percolation/Evaporation Pond

**Location of Proposed
Pipelines and Percolation
Ponds for Recycled Water
(Near-Term and Full Buildout)**

developments, it is anticipated that they will be similar to the Mission Lakes Golf Course. Table 5-4 shows the projected recycled water use by the various areas.

As previously stated, the projected wastewater generation will steadily climb, however it would not meet the total recycled water requirements for all three golf courses. Consequently, it is anticipated that recycled water distribution to each of the existing and proposed developments would be “phased in” depending on availability and proposed need. Table 5-5 shows the projected scheduling of recycled water use by various areas. Initially since Mission Lakes Golf Course is an existing facility, recycled water would be directed to this area first commencing in 2006. As recycled water becomes available, additional golf courses at Highland Falls and/or Cornerstone developments would be cycled into the proposed distribution system to receive recycled water.

Full Build Out Requirements

It is anticipated that the two previously mentioned wastewater treatment plants (WWTPs) would be built and that half (12.6 mgd) of the overall wastewater production (25.2 mgd) would be treated to tertiary standards. Figure 5-3 presents a proposed configuration of the recycled water distribution system for a full build out scenario.

5.2.3 Projected Wastewater Summary

In summary, wastewater generated is expected to rise from a current 1.0 mgd to approximately 4.0 mgd in Year 2009. According to the MSP, total build out could result in a daily wastewater production of 25.2 mgd. This production volume would necessitate the addition of two WWTPs along with the upgrading of existing treatment plants.

It is also anticipated that facilities (predominately turf irrigation at golf courses) would be available to receive nearly all of the treated recycled water available (assuming all is treated to tertiary standards) by the Year 2009.

Projections for wastewater generated during a full build out of the MSWD area suggest a daily production of 25.2 mgd. A preliminary estimate of 50% of total wastewater production or 12.6 mgd would be treated for recycled water use including turf irrigation and groundwater recharge.

TABLE 5-4**PROJECTED RECYCLED WATER USE BY VARIOUS AREAS**

Mission Springs Water District

SCENARIO	ANTICIPATED WATER USE		
	in gpm	in gpd	in ac-ft/year
Mission Lakes Golf Course	1,241	1,786,320	2,000
Highland Falls Golf Course	1,241	1,786,320	2,000
Cornerstone Golf Course	1,241	1,786,320	2,000
Percolation Ponds	1,000	1,440,000	1,612
TOTAL	4,722	6,798,960	7,612

TABLE 5-5
PROJECTED SCHEDULING OF RECYCLED WATER USE
IN MISSION SPRINGS WATER DISTRICT
YEARS 2005-2009

COMPONENT	EXISTING	YEAR					Full Build out
		2005	2006	2007	2008	2009	
Total Available Recycled Water Flow (gpd)	1,000,000	1,662,500	2,237,500	2,812,500	3,387,500	3,962,500	12,600,000
Recycled Water Use							
Mission Lakes Golf Course	0	0	1,786,000	1,786,000	1,786,000	1,786,000	1,800,000
Cornerstone Golf Course	0	0	0	1,000,000	1,600,000	1,786,000	1,800,000
Highland Falls Golf Course	0	0	0	0	0	390,500	1,800,000
Groundwater Recharge	1,000,000	1,662,500	451,500	26,500	1,500	0	7,000,000
Sub-Total	1,000,000	1,662,500	2,237,500	2,812,500	3,387,500	3,962,500	12,400,000
Reserve Flow (gpd)	0	0	0	0	0	0	200,000
TREATMENT CAPACITY (gpd)							
Existing	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	
Future	0	0	0	2,500,000	2,500,000	2,500,000	
Total	2,500,000	2,500,000	2,500,000	5,000,000	5,000,000	5,000,000	

5.3 Potential Uses and Associated Costs for Recycled Water

The potential uses for recycled water are heavily dependent on the degree of treatment provided as well as a distribution system that directs the recycled water to its intended use point.

We have separated the discussion into two areas: 1) probable costs associated with the intended treatment; and 2) probable costs associated with distribution. While many scenarios could be developed for various uses and associated distribution systems, Psomas focused on the most likely scenarios that are described in subsection 5.2.2. In the future, a more detailed cost analysis could be conducted based upon selected scenarios in consultation with the MSWD.

In providing opinions of probable cost, the user of this document understands that Psomas has no control over costs or the price of labor, equipment or materials or over the contractor's method of pricing, and the opinions of probable construction cost provided in this report are based on Psomas' qualifications and experience. Psomas makes no warranties, expressed or implied as to the accuracy of such opinions as compared to bid or actual costs.

5.3.1 Treatment Costs

Since the majority of the wastewater that is recycled in the early phases of the proposed plan will be used for irrigation on unrestricted golf courses, the type of treatment is assumed to be equivalent to DHS requirements for Disinfected Tertiary Recycled Water. In addition, it is assumed that a minimum level of contribution is required to maintain a total average daily flow to a golf course, which is assumed to be approximately 1.8 mgd.

Near-Term Recycled Water Treatment Requirements (Year 2005-2009)

For purposes of estimating treatment costs associated with generation of recycled water for reuse, it was assumed that the Horton WWTP would be upgraded to a capacity of 5.0 mgd in Year 2007 and that 100% of the total system capacity (or 5.0 mgd) would be treated to Disinfected Tertiary Recycled Water standards following DHS requirements.

Using a probable cost factor of \$5/gallon for design and construction costs, near-term build out costs for treatment of wastewater to tertiary standards would cost approximately \$25,000,000. Table 5-6 presents associated costs for achieving Disinfected Tertiary Recycled water standards under the near-term scenario.

TABLE 5-6
ASSOCIATED COSTS FOR ACHIEVING VARIOUS LEVELS OF WASTEWATER QUALITY
FOR EXISTING AND PROPOSED
TREATMENT PLANTS
Mission Springs Water District

TREATMENT PLANT	WASTEWATER GENERATION CAPACITY (gallons/day))	TREATMENT OPTION COST (in 000s)		
		Undisinfected Secondary Recycled Water	Recycled Water Generation Capacity (gallons/day)	Disinfected Tertiary Recycled Water (a)
Horton WWTP				
Current Capacity	2,500,000	None	---	---
Projected Capacity- Year 2009	5,000,000	None	5,000,000	\$25,000,000
Projected Capacity-Full Build Out	9,900,000	None	9,900,000	\$49,500,000
Desert Crest WWTP				
Current Capacity	180,000	None	---	---
Projected Capacity- Year 2009	180,000	None	---	---
Projected Capacity-Full Build Out	600,000	None	---	---
Regional WWTP				
Current Capacity	---	---	---	---
Projected Capacity- Year 2009	0	---	---	---
Projected Capacity-Full Build Out (b)	14,700,000	None	2,700,000	\$13,500,000
TOTAL				
Current Capacity	2,680,000	None	0	\$0
Projected Capacity- Year 2009	5,180,000	None	5,000,000	\$25,000,000
Projected Capacity	25,200,000	None	12,600,000	\$63,000,000

Notes:

- a) Cost is based on unit cost of \$5/gallon treated to tertiary standards (includes design & construction). Cost does not include O&M costs.
- b) Assumes only a portion of the wastewater produced would be treated to tertiary standards.

Full Build Out Requirements

For purposes of estimating treatment costs associated with generation of recycled water for reuse, it was assumed that 50% of the total system capacity (or 12.6 mgd) would be treated to Disinfected Tertiary Recycled Water standards following DHS requirements. Table 5-7 presents assumed flow rates for each of the existing and proposed WWTPs.

Table 5-7
Assumed Recycled Water Generation Capacity
for each WWTP at Full Build Out

WWTP	Wastewater Capacity (gallons/day)	Recycled Water Generation Capacity (gallons/day)
Horton WWTP	9,900,000	6,900,000
Desert Crest	600,000	0
Regional WWTP	14,700,000	2,700,000
TOTAL	25,200,000	12,600,000

Table 5-6 presents the associated costs for treating the wastewater to Disinfected Tertiary Recycled Water standards (as defined by DHS) under the full build out scenarios.

5.3.2 Distribution Costs

Near-Term Recycled Water Distribution Requirements (Year 2005-2009)

It is anticipated that the distribution lines would be sized to accommodate the “phasing in” of water distribution to major developments as well as anticipate recharging of the Sub-Basin groundwater when future production of recycled water exceeds demand for the recycled water. Table 5-8 presents the probable costs for the distribution system as depicted in Figure 5-3.

Full Build Out Requirements

It is anticipated that the near term recycled water distribution system would be present and operational and that the cost to complete the full build out would be in addition to the near term phase cost. Table 5-8 presents the probable costs for the additional work required to modify the existing recycle water distribution system for a full build out scenario.

TABLE 5-8
PROJECTED RECYCLED WATER USE DISTRIBUTION COSTS BY
VARIOUS AREAS
Mission Springs Water District

SCENARIO	Pipelines		Pump Stations		Total Cost (a)
	Length (feet)	Diameter (inches)	Size (horsepower) (b)	Cost (a)	
Near Term Build Out (2005-2009)					
Horton WWTP to Mission Lakes Golf Course	15,000	30	1,871	\$3,368,000	\$8,696,000
	6,000	26			
Horton WWTP to Highland Falls Golf Course (extension of existing line)	5,500	24	648	\$1,166,000	\$4,598,000
	16,500	18			
Horton WWTP to Cornerstone Golf Course	11,000	18	373	\$671,000	\$2,255,000
SUB-TOTAL - Near Term	54,000	—	2,892	\$5,205,000	\$15,549,000
Full Build Out					
Horton WWTP to Percolation Ponds (extension of existing line)	9,000	30	669	\$1,204,000	\$3,364,000
Regional WWTP to Highland Falls Interconnect	22,000	21	848	\$1,526,000	\$5,222,000
SUB-TOTAL - Full Build Out	31,000	---	1,517	\$2,730,000	\$8,586,000
TOTAL	85,000		4,409	\$7,935,000	\$24,135,000

Notes:

- a) Based on costs for current Year 2004.
b) Value represents total for all pumps that may be required as part of the overall distribution system.

5.4 Potential Funding Opportunities for Implementation of a Recycled Water Program

There are several programs which can assist municipalities in the funding of a recycled water program. For purposes of Psomas' review, it was assumed that the program would consist of treated wastewater that would be utilized for groundwater recharge and/or municipal uses including irrigation. A search was conducted and the following current or prospective funding opportunities were identified:

1) Water Recycling Funding Program - State Water Resources Control Board

Draft Program Guidelines are currently in the public comment period, with a Request For Proposal (RFP) anticipated in Fall 2004.

- **Water Recycling Facilities Planning Grant Program (Proposition 13 Loan Repayment Fund):** Provides grants for facilities planning studies to determine the feasibility of using recycled water to offset the use of fresh/potable water from state and/or local supplies. The grant will cover 50 percent of eligible costs up to \$75,000.
- **Water Recycling Construction Funding Program (Proposition 50 - \$42 million):** Provides grants up to 25 percent of construction costs or \$5 million, whichever is less, for projects that provide for treatment and delivery of municipal wastewater or groundwater contaminated due to human activity for uses (including groundwater recharge) that will offset imported water supplies. Projects must also provide direct benefits to the Delta by increasing the average water flow into the Delta, or reducing water pumping from the Delta. This program also offers low-interest loans for projects that do not meet the requirements mentioned above, but still include components of water recycling for local water supply benefits.

2. Integrated Regional Water Management (IRWM) Grant Program – State Water Resources Control Board (Proposition 50)

Program guidelines are currently in the public comment period, with an RFP anticipated in Fall 2004.

- **Planning Grant Program:** Provides \$10 million for planning grants that foster development or completion of IRWM Plans, to enhance regional planning efforts, and to assist more applicants to become eligible for Implementation Grant Funding.
- **Implementation Grant Program:** Provides \$150 million for projects that protect communities from drought, protect or improve water quality, improve local water security by reducing dependence on imported water and include at least one of the specified projects detailed in the application guidelines. Projects must be an implementation measure of an adopted IRWM Plan, and proposals must be submitted by a regional agency or regional group, as long

as at least one of the members is a public agency or non-profit entity. This is to encourage integrated regional strategies for management of water resources and promote a new model for water management.

-
- 3. **State Revolving Fund (SRF) Loan Program – State Water Resources Control Board (Clean Water Act)**
 - ***SRF Loan Program*** – Implements the Clean Water Act, among various State laws, and provides low-interest loan funding for construction of publicly-owned wastewater treatment facilities, local sewers, sewer interceptors, water reclamation facilities, as well as expanded use projects such as implementation of nonpoint source (NPS) projects or programs, development and implementation. There is no limit on the loan amount. Applications are currently being accepted (as of August 2004) to be placed on a priority list.
- 4. **I-Bank - Infrastructure State Revolving Fund (ISRF) Loan Program – CA Technology, Trade and Commerce Agency**
 - ***I-Bank Loan Program*** – Provides loans from \$250,000 to \$10 million with terms up to 30 years for any of the following types of projects: City streets, County highways, State highways, Drainage, Water supply and flood control, Educational facilities, Environmental mitigation measures, Parks and recreational facilities, Port facilities, Public transit, Sewage collection and treatment, Solid waste collection and disposal, Water treatment and distribution, Defense conversion, Public safety facilities, and Power and communications facilities. Applications are currently being accepted (as of August 2004) to be placed on a priority list.

5.5 Recommendations for Further Study

As part of the evaluation process, a number of issues have been raised concerning recycled water use, treatment requirements, distribution systems to take the recycled water to end use points, phasing of treatment and distribution, rates for usage of recycled water as well as policies related to all of the aforementioned issues. Psomas recommends development of a Recycled Water Master Plan that addresses these issues and includes the following:

- Refine projected recycled water demands and locations of end uses of recycled water;
- Hydraulic analysis of backbone treatment/distribution/storage systems for recycled water;
- Phasing of recommended facilities in conjunction with upgrades or improvements of existing and/or proposed WWTPs;
- Economic analysis including Capital & O&M costs;

- Financing/funding of proposed projects.

Moreover, Psomas recommends creating a Master Water Resources Plan that integrates all three plans including water, wastewater and recycled water as all of the proposed uses of and sources for water are dependent on one another.

6.0 CONCEPTUAL RECYCLED WATER MANAGEMENT OPTIONS

As previously indicated several areas of recycled water use are available or will become available in the Mission Springs Water District over the next 5-10 years. These areas include:

- Turf irrigation at unrestricted use golf courses, and;
- Groundwater recharge in the Mission Creek Sub-Basin.

However, several issues have been raised that will necessitate development of water management policies as well as a water management plan that integrates projected wastewater generation (Master Sewer Plan), water use (Water Use Plan) and recycled water use (proposed Recycled Water Plan) in the Mission Springs Water District area. The following discussion presents some of the issues that have been raised along with suggested policies that will have to be developed that will address these issues.

This section also describes the development of a conceptual recycled water program that addresses the issues raised, incorporates suggested policies and presents suggested options for recycled management in the MSWD area..

6.1 *Water Management Issues*

A number of issues have been raised concerning the use of water within the Mission Creek Sub-Basin. They include:

- declining groundwater levels in the basin due to overdraft of the Sub-Basin;
- concerns associated with the existing and future groundwater quality due to:
 - continued overdraft of the Sub-Basin;
 - impacts associated with continued operation of septic systems associated with residential, commercial and industrial operations;
 - impacts associated with recharge operations from imported water and/or wastewater discharge
- concerns associated with recycled water usage including;
 - availability of treatment and distribution systems within the basins
 - phasing of use with proposed developments
 - financial burden and rate structure for recycled water use
- Coordination of overall water use, water availability and recycled water availability with proposed growth and development in the Mission Creek Sub-Basin.

6.2 Water Management Policies

It is expected that specific policies will have to be formulated to address the issues previously raised concerning recycled water management as well as overall water management in the Mission Creek Sub-Basin. The following items represent examples of policies that could be adopted to address some of the issues raised.

- All new developments (of a specific size) must have a program for utilizing recycled water for large consumptive use areas including but not limited to: turf irrigation, non-contact lakes
- All new developments (of a specific size) must have a program to promote natural recharge of stormwater runoff on the property
- Prohibit/restrict the use of underground storage tanks, chemical storage, and/or other activities that could pose a threat to underlying groundwater system in the Mission Creek Sub-Basin, and;
- Initiate a groundwater management program that set forth specific monitoring requirements and actions to be taken

The previously mentioned policies are not all inclusive. Additional issues may arise that require specific policies to be developed and implemented. Consequently, the policies presented here are considered generic and applicable to areas having similar types of issues and are subject to revision.

6.2 Conceptual Recycled Water Management Program

It is believed that in order to develop a conceptual recycled water management program that a Recycled Water Plan would have to be developed. The purpose of the Recycled Water Plan is to provide sufficient information for the technical and economic evaluation of a recycled water infrastructure to:

- accommodate demand for recycled water in the Sub-Basin;
- accommodate the management of increased sewer flows that are generated as a result conversion of private septic systems and overall growth in the area;
- Provide for future demand for recycled water from growth and for recharge of the groundwater in the Sub-Basin.

The Plan should cover the following areas:

Existing and Projected Study Area Characteristics-the objective of this section is to describe the study area, existing population and expected growth, the environmental setting along with any environmental constraints, engineering constraints, existing land use and projected land use including known developments, projected recycled water characteristics, and projected recycled water uses in the area.

Analysis Criteria – the objective of this section is to describe the criteria that will be used to project the quantity of recycled water delivered to various entities depending on use, demand, and location within the Sub-Basin.

Projected Recycle Water Use – the objective of this section is to describe the anticipated recycled water use based on existing facilities and projected developments in the area. It would separate the area into recycled water use boundaries, what total design flows would be attributed to each boundary and routing of the projected recycled water use from each of the WWTPs where recycled water would be generated.

Proposed System Analysis – the objective of this section is create a hydraulic model of the proposed recycled water system to test near term build out scenario (Year 2005-2009) versus full build out scenario to make sure that the system would accommodate anticipated development in the Mission Creek Sub-Basin.

Capital Improvement Program – the objective of this section would be to derive costs associated with construction and operation of a recycled water system including treatment and distribution systems.

Coordination/Sequencing of Improvements with Sewer and Water – the purpose of this section is assist in coordination/sequencing of improvements/upgrades to existing systems (sewer, water) with projected improvements for the proposed recycled water system to minimize overall cost, minimize impacts to the community and the environment, and maintain functionality of existing and proposed systems to meet future growth demands.

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